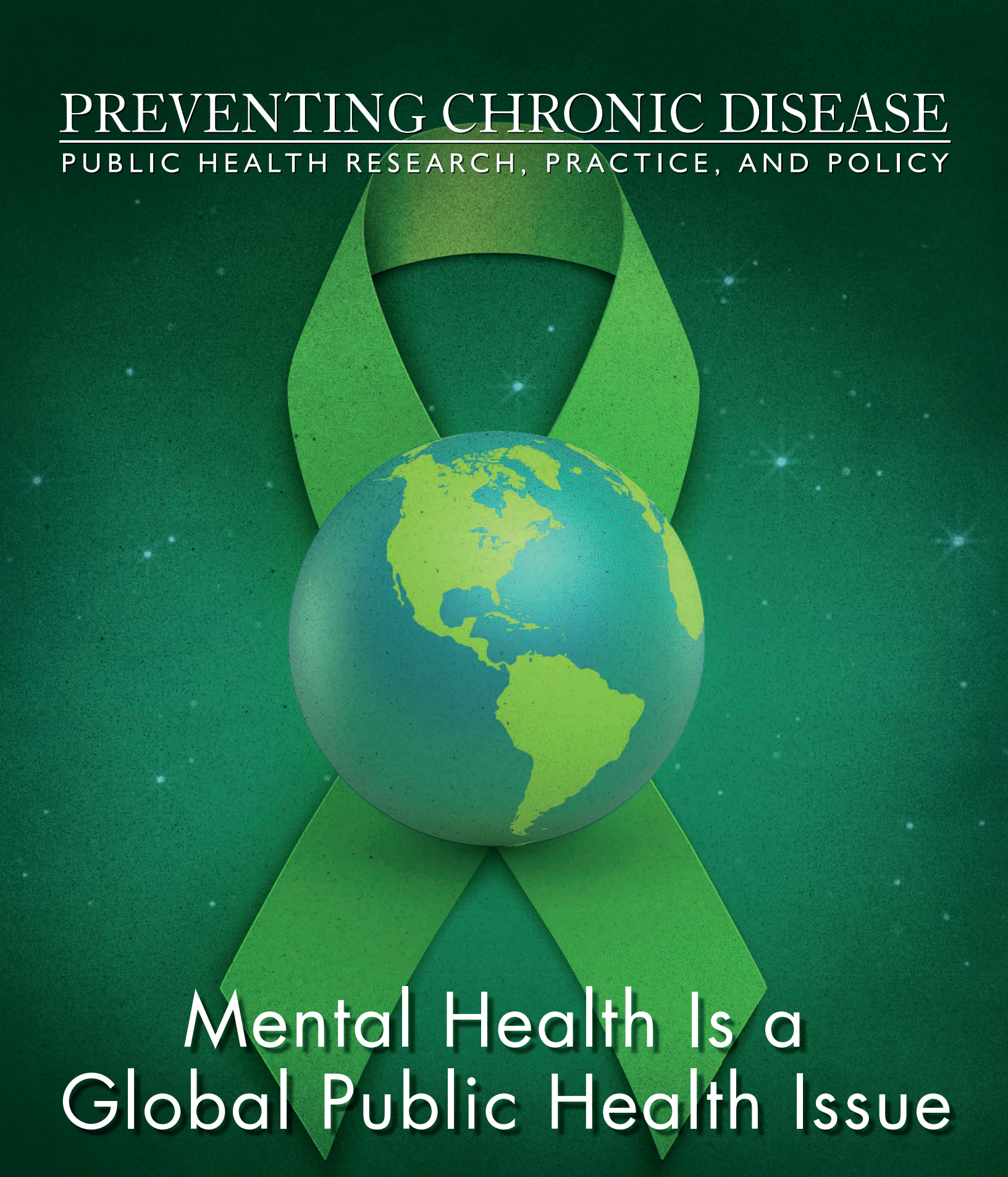
PREVENTING CHRONIC DISEASE
PUBLIC HEALTH RESEARCH, PRACTICE, AND POLICY



Mental Health Is a Global Public Health Issue

About the Cover: *The green ribbon represents the commitment to raising mental health awareness and ending stigma and discrimination.*

U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

Introduction

Mental, emotional, and psychological health have garnered increased attention as a major public health issue. Mental health includes not only the traditional focus on individual therapy interactions but also emerging frameworks designed to address mental health at the population health level. Health is shaped by a plethora of determinants (eg, genetics, gender, socioeconomic status, education, physical environment, social support networks, access to health services) that operate at the individual, family, community, health systems, and societal levels. Because these determinants of health affect not only physical health but also psychological health, it's imperative in public health to gain a better understanding of the many pathways through which determinants of health impact the psychological well-being of large groups of individuals.

Over the past 5 years, Preventing Chronic Disease (PCD) has received an increase in submissions addressing aspects of mental health and chronic disease. PCD is pleased to release this collection, Mental Health Is a Global Public Health Issue, which consists of 10 articles that examine relationships between family history, self-care practices, sleep, obesity, educational attainment, and depression. This collection also includes 2 articles from our previously published **COVID-19 special supplement:** one that addresses the critical need for a population approach to improve the nation's behavioral health during the COVID-19 pandemic, and one that offers recommendations on keeping parks and green spaces accessible to promote mental and physical health. We hope this collection contributes to ongoing efforts to provide reliable, peer-reviewed research and proven practices to improve health outcomes worldwide in mental health and chronic disease. The topics featured below represent areas in which future submissions would be of great interest to the journal, and PCD will continue to release timely peer-reviewed articles on mental health issues in chronic disease as new information comes available.

Leonard Jack, Jr, PhD, MSc
Editor in Chief, Preventing Chronic Disease

About the Journal

Preventing Chronic Disease (PCD) is a peer-reviewed public health journal sponsored by the Centers for Disease Control and Prevention and authored by experts worldwide. PCD was established in 2004 by the National Center for Chronic Disease Prevention and Health Promotion with a mission to promote dialogue among researchers, practitioners, and policy makers worldwide on the integration and application of research findings and practical experience to improve population health.

PCD's vision is to serve as an influential journal in the dissemination of proven and promising public health findings, innovations, and practices with editorial content respected for its integrity and relevance to chronic disease prevention.

PCD Staff

Associate Editors

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COMMENTARY

The Critical Need for a Population Health Approach: Addressing the Nation's Behavioral Health During the COVID-19 Pandemic and Beyond

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Summary

What is known about this topic?

Behavioral health needs in the United States are not being met by the current health care system, and the COVID-19 pandemic will likely dramatically increase the need for psychological services.

What is added by this report?

Adopting a population health approach provides opportunities to target interventions to those populations and communities most in need of psychological health care services, with the potential of preventing development of disorders.

What are the implications for public health practice?

Implementing and evaluating population health strategies to promote overall well-being requires system change that translates to policy decisions and programs to meet the needs of local communities.

Abstract

The COVID-19 global pandemic highlights the necessity for a population health approach to identify and implement strategies across systems to improve behavioral health. Adopting a population health approach helps to address the needs of the total population, including at-risk subgroups, through multiple levels of intervention and to promote the public's behavioral health and psychological well-being.

Introduction

Calls to bring a population health framework to the nation's health care system have been increasing. Although this approach had been steadily gaining traction for physical health (1), using this approach with respect to behavioral health (ie, mental health and substance use conditions) has only recently been considered (2,3). However, the need for this approach has never been so apparent as it is during the coronavirus disease 2019 (COVID-19) pandemic. Individuals and communities are grappling with the spread of the virus, the struggle to effectively treat all infected individuals, and the challenges of physical distancing and quarantine, all while attempting to reopen the economy. These challenges, along with the economic impact of prolonged school and business closures and high levels of stress and uncertainty, exact a tremendous psychological toll on many people in the United States (4). The existing capacity of the US health care system to address the resulting behavioral health needs is severely limited (5). A population health approach is needed to address the impact of the COVID-19 pandemic and the inadequacies of the nation's current approach to behavioral health needs, which have been magnified during the pandemic (6).

The current approach to behavioral health care in the United States is primarily a one-on-one approach that focuses on individuals who have a clinical diagnosis (7). This approach drastically limits the number of people for whom the appropriate level of care is available, let alone addressing the needs of those whose level of psychological distress does not reach the diagnostic threshold. As a result, many people with high levels of stress and uncertainty are left without appropriate psychological support and miss the opportunity for prevention and early intervention.

The Definition and Application of Behavioral Health

Behavioral health encompasses traditional mental health and substance use disorders, as well as overall psychological well-being

(8). Behavioral health can be understood as the behaviors that affect physical and mental health, and good behavioral health results in a "state of mind characterized by emotional well-being, good behavioral adjustment, relative freedom from anxiety and disabling symptoms, and a capacity to establish constructive relationships and cope with the ordinary demands and stresses of life" (9). Obtaining and maintaining behavioral health requires flexibility, the ability to understand and manage emotions, engaging in behaviors that are healthy for the body and the mind, awareness of one's relationship to others and recognition of one's responses, and effectively employing strategies to deal with the demands of living.

The manifestation of behavioral health varies over the lifespan and across cultures. Similarly, the large number of factors that influence behavioral health must also be acknowledged: genetics, family environment, discrimination, socioeconomic status, traumatic experiences, physical health, loneliness, culture, and a host of others (10). Supporting behavioral health often means addressing social determinants of health through an array of social and community factors (11). For instance, when individuals and communities lack economic stability, physical survival alone can be a challenge. The focus is on getting what is needed to live, which will not necessarily include what is needed to thrive. Integrating behavioral health with community access to job training programs is one example of increasing access to behavioral health services and to psychological skill development to help individuals navigate the challenges of seeking employment.

We need to be as concerned about a population's psychological well-being as we are about its physical well-being. Psychological well-being is neither a categorical nor a permanent state. That is, people are not either mentally healthy or unhealthy (eg, meeting diagnostic criteria for a psychological disorder, such as depression or schizophrenia; developing a substance use problem). A person's or population's overall psychological well-being falls on a continuum and changes over time. To truly recognize and support degrees of mental wellness on that continuum requires changing how we identify and meet the behavioral health needs of the population.

Specialist Health Care Framework Is Insufficient

How behavioral health is addressed within our health care system must change. Currently, one must typically have a diagnosis to have care covered by insurance; therefore, early intervention and prevention is difficult, and in many places in the United States, access to services is limited (12). Furthermore, specialist behavioral health care professionals, such as psychologists and psychiatrists, work in settings distinct from where most of individuals live, work, play, and worship, creating both physical and psychological barriers to access.

Although more integration of professionals who specialize in behavioral health care into primary care and other settings has occurred, the trend is not universal and it does not go far enough in reaching people in other settings. In instances in which this integration has occurred, the behavioral health expert has the capacity to immediately meet with individuals who have identified behavioral health needs, triage the concerns, and determine appropriate next steps, thereby reducing the number of individuals who are "lost" in the transition to specialty care. Also, the psychologist or other behavioral health care professional frequently provides consultation and support to nonbehavioral health care professionals, helping to educate them as well as reduce the stigma often associated with patients who have behavioral health care needs (13). Integrated care improves on our current approach by providing a range of interventions and reaching people "where they are" (13). This approach, similar to a population health approach, emphasizes addressing behavioral health needs — regardless of whether the person has a diagnosis — and building the capacity of the setting to address behavioral health needs along a continuum.

Addressing behavioral health within the health care system alone is not sufficient. Many individuals do not have a regular primary care provider. Of those who do, the behavioral health needs being addressed are those further along the continuum toward distress, impairment, and disorder. Because only 50% of individuals with behavioral health concerns actually enter any form of treatment (14), we must develop new strategies to reach people wherever they are — at work, in school, and in the community. Furthermore, we must engage the communities themselves, which have the wisdom to address many of these problems but may need the resources and expertise of mental health professionals to do so.

Scope of Needs During the COVID-19 Pandemic

Behavioral health needs have long been insufficiently met in the United States, and the population is now facing increasing psychological stress and significant growing needs as the pandemic unfolds (15). According to a survey conducted by the American Psychological Association (APA), the average stress level reported by US adults in May 2020 was significantly higher than that reported in the 2019 survey (data collected in August), and it is the first significant increase in average reported stress since APA first started surveying American households about stress more than a decade ago (16). Furthermore, some groups in the APA survey, such as

parents with children younger than 18 and Hispanic adults, reported even higher levels of stress. Stress that is not addressed can become chronic and result in physical and behavioral health problems such as cardiovascular disease, obesity, inflammation, and depression (17).

Analyses from previous pandemics (18,19), as well as studies about COVID-19 coming from China (20) and Italy (21), indicate that we should expect an increase in a variety of behavioral health symptoms, especially among front-line health care workers. Emerging data suggest that health care workers treating individuals with COVID-19 are reporting significant distress and symptoms of depression, anxiety, and insomnia (22). At a minimum, those on the front lines of addressing COVID-19 need onsite emotional support and the capacity to meet their own basic needs such as obtaining food, transportation, and personal protective equipment. Some of those on the front lines experiencing distress will want and benefit from more focused, brief psychological interventions intended to provide them with skills that enable them to cope with highly stressful work situations (eg, Psychological First Aid, Skills for Psychological Recovery) (23). Unfortunately, many hospitals are not set up to provide this kind of psychological support (24,25).

Furthermore, a 2020 systematic review of the psychological impact of quarantine indicated that individuals experience an array of negative effects, including anger, confusion, and posttraumatic stress symptoms (26). These effects are heightened when quarantine is of a longer duration, people have fears of infection, receive inadequate or unclear information, and face financial loss. If the pandemic is similar to other community traumas (27), most individuals will adapt and demonstrate resilience, but a minority will develop a behavioral health condition that requires intervention.

The long-term population health needs resulting from the pandemic could be substantial. Although humans are remarkably resilient, some individuals benefit from psychological intervention. In addition to workers on the front lines (eg, health care professionals, essential workers) who may develop disorders such as depression or posttraumatic stress disorder as a result of their experiences treating individuals with COVID-19, many other segments of the US population (and worldwide) are also likely to need interventions in some form. In the current environment of quarantine and physical distancing, patients with COVID-19 are typically separated from their families and do not have the benefit of the close emotional support and physical help of their loved ones.

The families and friends of patients with COVID-19 experience high levels of stress, which is magnified in cases in which they are unable to be present when their loved ones die. Furthermore, because traditional funerals and other rituals are not possible in the current environment, survivors must create new ways to mourn. Individuals who survive COVID-19 may have major behavioral health needs that we are only beginning to understand. For instance, research makes clear that the experience of being on a ventilator and staying in an intensive care unit for an extended period of time can be traumatic (28,29). Some individuals may face cognitive challenges as they recover from the infection, which necessitates specialized behavioral health care (30).

In addition to the large numbers of individuals who have had direct experience with COVID-19, the US population has also experienced some degree of stress as a result of the nation's sweeping efforts to reduce transmission of the virus. Many individuals have struggled to cope with the uncertainty of stay-at-home orders, changes in work and financial status, facilitating their children's online schooling, virus-related discrimination, and major disruptions in routines and plans. Each of these factors poses the potential for the development of ongoing stress and its fallout. Of particular concern are people facing both significant financial distress and experiencing discrimination, as both of these stressors are linked to the development of future behavioral health problems (31,32).

Adopting a Population Health Framework

In the face of this kind of population distress, the importance of using public health strategies, rather than relegating behavioral health to treatment by specialist providers only, cannot be overstated. Promoting population behavioral health has the potential to increase overall resiliency and reduce the number of individuals who ultimately develop behavioral health problems, and improvements in behavioral health can also lead to improvements in physical health (33). This crisis, although difficult, can provide an opportunity to make this shift. Philadelphia (34) and New York City (35) have adopted a population health approach to behavioral health and provide models for how to begin. Key aspects of this work include the necessity of reimagining what a behavioral health system is and how one operates and to establish a broad, evidence-based vision of what that entails.

This change needs to happen both at the national and the local level. National leadership can highlight issues, advocate for resources, and encourage solutions, but implementation must take place at the local level to best meet community needs. Unfortunately, many local health governments are not actively engaged in systematic activities to promote behavioral health. Although local leaders often recognize the priority of doing so, they often do not control the behavioral health resources in their communities, which are often administered at the state or county level. Con-

sequently, local leaders cite as barriers limited resources, knowledge, and data along with the challenges of communicating and collaborating with local behavioral health agencies (36). Increasing partnerships between these local governments and behavioral health funding agencies is essential for success.

The American Psychological Association (APA) is using a population health framework to tackle the emerging behavioral health issues associated with this pandemic. APA has identified several principles to guide this work (Box), conceptualized as taking place across 3 broad levels of the population: 1) those with behavioral health conditions requiring clinical intervention, 2) those who are experiencing subclinical psychological distress or who are at great risk for experiencing clinically significant behavioral health problems, and 3) those who are relatively healthy.

Box. Principles Guiding Population Health Framework for Behavioral Health at the American Psychological Association

- Use data and the best available science to inform policies, programs, and resources.
- Prevent when possible and otherwise intervene at the earliest moment.
- Strategize, analyze, and intervene at the community/population level (in addition to the individual).
- Reach broad and diverse audiences through partnerships and alliances.
- Utilize a developmental approach (eg, change over time, age-appropriate interventions).
- Consider the "whole person" and the structural/systemic factors impacting individual behavior.
- Be culturally sensitive while also thinking transculturally.
- Recognize that inherent in every community is the wisdom to solve its own problems.
- Champion equity by addressing systemic issues (eg, social determinants of health, access to treatment).

Strategies and interventions must be tailored to achieve the health goals at each of these levels. *Indicated* approaches to behavioral health target the first level. These approaches are often provided by specialists, such as psychologists, to individuals with clear problems or disorders and use evidence-based strategies to reduce symptoms and improve functioning. *Selective* approaches to behavioral health are designed to reduce risk or mitigate the impact of risk factors that lead to psychological distress, for example using targeted, scalable interventions designed to build people's ability to adapt and cope. *Universal* approaches are intended to promote general behavioral wellness, with a focus on messages to the public to destigmatize mental illness, promote psychoeducation about responses to stress, and focus attention on the foundation necessary to support and maintain psychological well-being.

A population health approach has, as its goal, optimal behavioral health and wellness across the continuum of need. This approach addresses the need to "get upstream" as it promotes intervention before individuals need clinical services. It also shifts the goal of practitioners to behavioral wellness and not just the absence of psychopathology. Because this is a significant paradigmatic shift for most behavioral health professionals and the systems in which they work, we will need to develop leaders and professionals who can work from this public health perspective. From a systems perspective, individual localities should determine their own needs and collaboratively work with local experts — members of the public, scientists, providers, policy makers, and others — to design and implement the programs that each community needs.

Implications for Public Health

The pandemic has elevated stress levels nationwide, with serious implications. Chronic stress is linked to greater risk for a range of adverse health outcomes, so adopting a rigorous, evidence-based approach to identifying needs and designing interventions is critical. In the United States, there have been some effective public education campaigns to encourage handwashing, physical distancing, and mask wearing to slow the spread of the coronavirus. Similarly, key messages can be developed and used to increase the public's capacity to handle stress, cope with the current uncertainty, and manage distress to slow the development of behavioral health problems. The opportunity to act is now, before a behavioral health pandemic develops and accelerates and too many lives are disrupted or lost.

Using a population approach to behavioral health holds much promise. It will allow us to address many long-standing issues that affect our current behavioral health system by placing a greater emphasis on prevention and early intervention and by reaching underserved subgroups. It will also enable us to simultaneously and effectively address the potential surge in need caused by the COVID-19 pandemic. The challenge will be reorienting and training the workforce to adopt this perspective, develop new interventions, and build the service infrastructure to meet a broader range of behavioral health needs. Furthermore, we need to develop a fiscal and regulatory policy framework to support this work. Finally, evaluation of these changes can be essential to determine how future population health approaches can be effective at improving not only the psychological well-being of those impacted by COVID-19 but also the overall behavioral health of the US population. Although there are important examples of the successful implementation of a population mental health approach, these are rare exceptions. The behavioral health pandemic that is likely to emerge as a result of COVID-19 creates urgency and should spur immediate action. We have a window of opportunity where

the public and policy makers can see firsthand that behavioral health concerns are affecting a large proportion of the population and that we need an approach and the resources to address the full range of these concerns. Action must be taken for the health and well-being of our nation.

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ORIGINAL RESEARCH

The Joint Effect of Physical Multimorbidity and Mental Health Conditions Among Adults in Australia

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Summary

What is already known on this topic?

Empirical studies suggest that multiple physical health conditions (physical multimorbidity) coupled with a mental health condition are associated with a wide range of adverse health, economic, and social outcomes.

What is added by this report?

After adjusting for confounding factors, our study showed that physical multimorbidity accompanied by mental health conditions and low socioeconomic status increased the use of health care services while reducing work productivity and health-related quality of life.

What are the implications for public health practice?

The Australian health system should prioritize improving the management of people with multimorbidity by using a more patient-centered approach that fosters integration of treatments for physical and mental health conditions.

Abstract

Introduction

The prevalence of chronic physical and mental health conditions is rising globally. Little evidence exists on the joint effect of physical and mental health conditions on health care use, work productivity, and health-related quality of life in Australia.

Methods

We analyzed data from the Household, Income and Labour Dynamics in Australia (HILDA) Survey, waves 9 (2009), 13 (2013), and 17 (2017). Economic effects associated with multimorbidity were measured through health service use, work productivity loss, and health-related quality of life. We used generalized estimating equations to assess the effect of the association between physical multimorbidity and mental health conditions and economic outcomes.

Results

From 2009 through 2017 the prevalence of physical multimorbidity increased from 15.1% to 16.2%, and the prevalence of mental health conditions increased from 11.2% to 17.3%. The number of physical health conditions was associated with the number of health services used (general practitioner visits, incidence rate ratio = 1.41), work productivity loss (labor force participation, adjusted odds ratio = 0.71), and reduced health-related quality of life (SF-6D score: Coefficient = −0.03). These effects were exacerbated by the presence of mental health conditions and low socioeconomic status.

Conclusion

Having multiple physical health conditions (physical multimorbidity) creates substantial health and financial burdens on individuals, the health system, and society, including increased use of health services, loss of work productivity, and decreased health-related quality of life. The adverse effects of multimorbidity on health, quality of life, and economic well-being are exacerbated by the co-occurrence of mental health conditions and low socioeconomic status.

Introduction

Chronic health conditions account for most of the world's premature deaths and through their combined social, cultural, and economic effects are also major contributors to socioeconomic inequalities. The rise in morbidity and mortality associated with these conditions is influenced by population ageing and by socioeconomic, societal, and lifestyle changes (1), factors that also contribute to the increase in the prevalence of multimorbidity (defined as the presence of 2 or more health conditions) (2). In Australia, approximately half the population has at least 1 health condition, and 90% of deaths are due to them (3).

Multimorbidity is associated with a wide range of adverse health, economic, and social outcomes; people with multimorbidity have more complex health care needs (use multiple health services and treatments), poorer physical functioning, and increased disability and mortality (4,5). Multimorbidity is also associated with increased economic costs (both medical and nonmedical) and out-of-pocket spending for medical care (6–9). The effect of multimorbidity on financial status as a result of treatment costs has been well documented (10,11). Less is known about other social effects of multimorbidity, such as its effect on loss of work productivity.

Multimorbidity can involve combinations of both physical and mental health conditions, which often have complex and bidirectional interrelations (12). These combinations can exacerbate disease burdens and socioeconomic outcomes (13–15).

In our study, we used nationally representative survey data from Australia 1) to examine the distribution of physical multimorbidity in relation to the presence of mental health conditions by socioeconomic status and 2) to measure the economic burden of combined physical multimorbidity and mental health conditions on health-related quality of life (HRQoL), health service use, and loss of work productivity.

Methods

Sample and data

We used panel data from 3 waves of the Household, Income and Labour Dynamics in Australia (HILDA) Survey conducted in 2009, 2013, and 2017 (16). Briefly, the HILDA Survey is a nationally representative longitudinal survey that collects information on economic and personal well-being, labor market dynamics, and family life in Australian households among individuals aged 15 years or over. Commenced in 2001, the HILDA Survey collects data from the same households and individuals for each year of the survey. A detailed description of survey objectives and methods are provided elsewhere (16). Waves 9, 13, and 17 of the HILDA Survey comprised 13,301, 17,501, and 17,571 respondents, respectively. In our analysis, we included respondents aged 15 or older and excluded those who had missing values on independent variables and health conditions. This left a study sample of 13,284 respondents for wave 9, 17,459 for wave 13, and 17,527 for wave 17 (Figure 1).

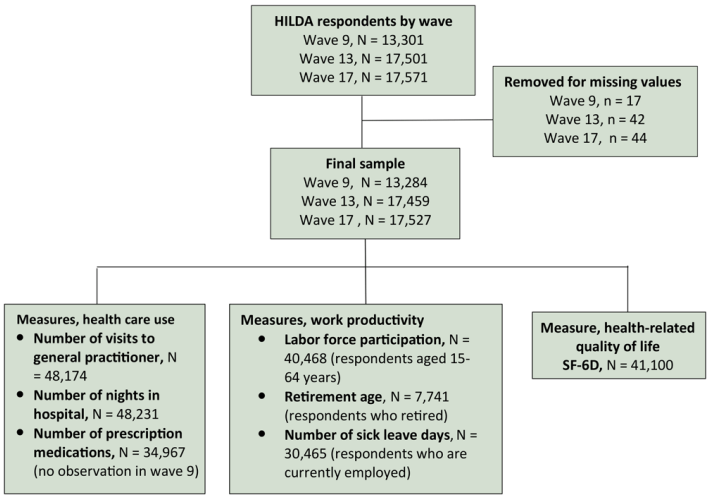

Figure 1. Flowchart showing selection of respondents from HILDA Survey and measures used to evaluate health service use, loss of work productivity, and reduced health-related quality of life (HRQoL). To assess HRQoL we used the SF-6D, which consists of 11 questions in 6 domains (physical functioning, role limitation, social functioning, pain, mental health, and vitality) from the SF-36, the 36-item short form questionnaire for evaluating HRQoL (17).

Variables

Multimorbidity. We assessed whether respondents had both physical multimorbidity and mental health conditions. The list of physical health conditions included in the HILDA Survey were arthritis/osteoporosis, asthma, cancer, chronic bronchitis/emphysema, type 1 diabetes, type 2 diabetes, heart disease, high blood pressure/hypertension, and any other serious circulatory condition. Mental health conditions included in the HILDA Survey were depression/anxiety and "other mental illnesses." Respondents who answered affirmatively to the question "Have you been told by a doctor or nurse that you have any of these conditions?" were defined as reporting a health condition. We counted the number of self-reported physical health conditions, excluding mental health conditions, to quantify the number of physical health conditions and categorized people with more than 1 physical health condition as having physical multimorbidity (0 = no physical multimorbidity, 1 = physical multimorbidity). Because the HILDA Survey did not ask about type of mental health condition apart from depression and anxiety, we were not able to create a count variable for men-

tal health conditions. Instead, we included the presence of any mental health condition as a separate binary variable (0 = no mental health condition1 = mental health condition).

Outcomes. We examined 3 types of costs associated with physical and mental multimorbidity, including 1) direct costs measured by health service use, 2) indirect costs measured by work productivity loss, and 3) intangible costs measured by health-related quality of life (HRQoL). Use of health services was measured by the number of visits to a general practice (GP) physician in the past 12 months, the number of overnight stays in a hospital in the past 12 months, and the number of reported prescription medications taken on a regular basis in the past 12 months (16). Respondents who reported 5 or more prescription medications were assigned polypharmacy status, and those who reported 10 or more prescription medications were assigned excessive polypharmacy status. Second, work productivity was measured by labor force participation status, retirement age, and mean number of days of sick leave taken per year. Labor force participation status was defined as the respondent's employment status (in labor force, not in labor force) at the time of the survey. Respondents were categorized in "labor force participation" if they were either currently working or were unemployed but actively looking for a job. Retirement age was defined as the age when the respondent retired. This question was asked only of respondents who were retired at the time of the survey. Absence from work was assessed on the basis of the number of paid sick leave days taken by respondents who were employed at the time of the survey. Finally, to assess HRQoL we used the SF-6D, which consists of 11 questions in 6 domains (physical functioning, role limitation, social functioning, pain, mental health, and vitality) from the SF-36, the 36-item short form questionnaire for evaluating HRQoL (17). The SF-6D provided a nondisease-specific measure of respondents' health status and experience and assigned a continuous value between 0 (worst health state) and 1 (best health state).

Covariates. Control variables included for the analysis were sex, age (age in years at wave 9), education level (low level, year 11 and below; middle level, year 12, certificate iii or iv, diploma, advanced diploma; high level, bachelor or honors, graduate diploma, graduate certificate, post graduate); Indigenous status (non-Aboriginal, Aboriginal, and Torres Strait Islander); country of birth (Australia, other English-speaking countries [United Kingdom, New Zealand, Canada, United States, Ireland, or South Africa]; all others); marital status (married/cohabiting, other [single, separated, divorced, widowed]); Australian state (New South Wales, Victoria, Queensland, South Australia, Western Australia, Tasmania, Northern Territory, Australian Capital Territory); residential area (rural, urban); and wave number (coded as 0 in wave 9, 1 in wave 13, and 2 in wave 17). To create the socioeconomic status (SES) quintile, we used Socio Economic Indexes for Areas (SEIFA), a scale of 1 to 5 in which 1 is the lowest SES group and 5 is the highest. SEIFA is an index based on social and economic census data from 2011 that ranks geographic areas across Australia according to relative socioeconomic advantage and disadvantage (18).

Statistical analysis

Because HILDA data included repeated measurements of individuals over time, we used generalized estimating equations (GEE) with an unstructured covariance matrix and robust standard errors to estimate the outcome–exposure relationship while accounting for within-person correlation. Different families of GEE were used depending on the outcome of interest. The negative binomial family with a logit link function was used for count-based outcomes (number of GP visits, number of nights in hospital, number of prescription medications, number of days of sick leave), and coefficients were interpreted as the increase in number for each unit increase of the associated variable. The binomial family with a logit link function was used to calculate binary outcomes (polypharmacy, excessive polypharmacy, labor force participation) and odd ratios. We used the Gaussian family with an identity link function for continuous outcomes (retirement age, SF-6D score of HRQoL) with coefficients interpreted as linear changes in the outcome. Each model included all covariates. We also examined the longitudinal association between the presence of a mental health condition (at baseline) and physical multimorbidity (over time), and also the association between physical multimorbidity (at baseline) and a mental health condition (over time). For the longitudinal analysis, we used binomial GEEs with a logit link and included time (measured in years from baseline) and the time–exposure interaction in the model.

Additionally, we conducted 2 sets of sensitivity analyses to test the robustness of our models. First, we re-analyzed each association by using balanced samples to compare the results analyzed by using unbalanced samples. Second, we compared the differential effect of mental health conditions by replacing the model's exposure variable "mental health condition," which encompassed all mental health conditions, with either 1) depression/anxiety or 2) other mental illnesses. All analyses were performed using Stata 15 (Stata Corp).

Results

Sample characteristics

Women accounted for approximately half of the samples. In all 3 waves, most respondents were aged younger than 50, had a middle education level, and were married/cohabiting. Respondents report-

ing mental health conditions represented 11.2% of the sample in 2009 and 17.3% in 2017. The proportion of respondents with physical multimorbidity was 13.3% in 2009 and 14.5% in 2017 amongst respondents who did not report mental health conditions and 29.5% in 2009 and 24.2% in 2017 amongst those reporting mental health conditions.

Physical multimorbidity and mental health conditions by SES. For both men and women, the prevalence of physical multimorbidity was higher among the lowest SES group than among the highest SES group in all waves (Figure 2). For example, 19.1% of male respondents with the lowest SES had physical multimorbidity in 2013 compared with 10.8% among those with the highest SES. We also observed this trend for the prevalence of mental health conditions. The prevalence of mental health conditions among women with the lowest SES (21.5%) was almost double that of respondents with the highest SES (11.5%) in 2013. It is worth noting that the increase in the prevalence of these conditions as well as the number of physical health conditions by waves reflects the ageing effect of the sample.

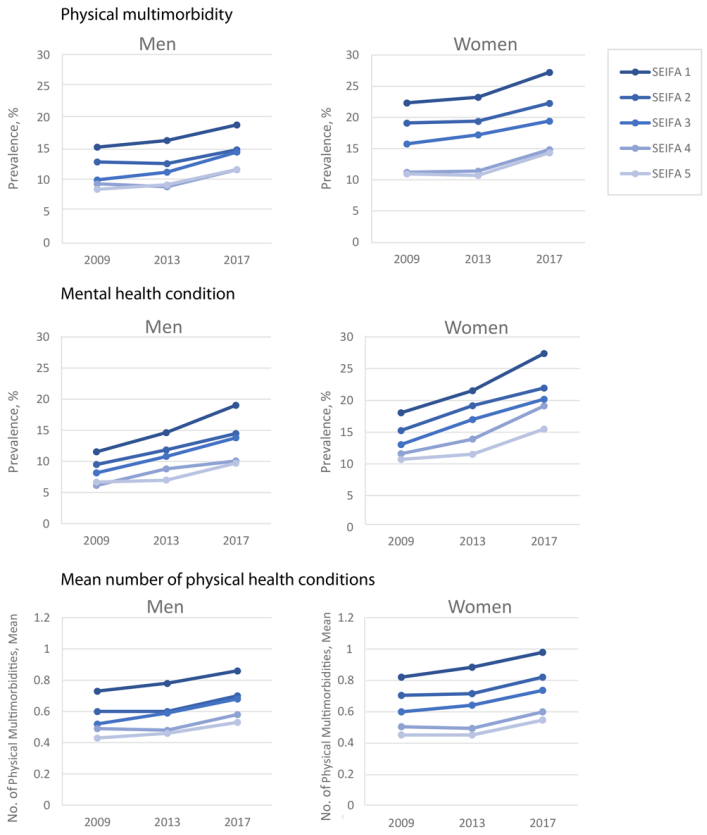

Figure 2. Prevalence of physical multimorbidity and mental health conditions and the mean number of physical health conditions across 3 waves of the Household, Income and Labour Dynamics in Australia (HILDA) Survey, 2009, 2013, and 2017, by sex and socioeconomic status. Socioeconomic status is measured on the SEIFA (Socio Economic Indexes for Areas) scale and ranges from 1 to 5, with 5 being the highest status (18).

Longitudinal association between physical multimorbidity and mental health condition. We saw a clear association between physical multimorbidity and mental health conditions (Table 1). The presence of a mental health condition was associated with an increased risk of physical multimorbidity (adjusted odds ratio [AOR] = 3.44; 95% CI, 3.00–3.95). Physical multimorbidity was associated with an increased risk of a mental health condition (AOR = 3.10; 95% CI, 2.73–3.53). Adjusting for baseline age, with each year the risk of physical multimorbidity increased with time where there was no mental health condition at baseline (AOR = 1.08; 95% CI, 1.07–1.09). Where there was a mental health condition at baseline, the increased risk over time was negligible (AOR = 1.02; 95% CI, 1.00–1.04). Likewise, the risk of a mental health condition increased with time where there was no physical multimorbidity (AOR = 1.08; 95% CI, 1.07–1.09), and where the risk of physical multimorbidity was smaller (AOR = 1.02; 95% CI, 1.01–1.04).

Association between physical multimorbidity, mental health, and low socioeconomic status

Health service use. An increase in the number of physical health conditions was associated with a greater number of GP visits (incidence rate ratio [IRR] = 1.41; 95% CI, 1.39–1.43) and the number of nights in hospital (IRR = 1.77; 95% CI, 1.68–1.87) (Table 2). The presence of a mental health condition was also associated with an increasing number of GP visits (IRR = 2.11; 95% CI, 2.03–2.20) and the number of nights in hospital (IRR = 3.59; 95% CI, 2.93–4.41). Low SES was also associated with the number of GP visits (ie, respondents with the lowest SES had an increased number of GP visits [SEIFA1: IRR = 1.23; 95% CI, 1.19–1.29] compared with those with higher SES.

An increased number of physical health conditions was associated with an increase in the mean number of prescription medications used (IRR = 1.75; 95% CI, 1.72–1.78), the odds of polypharmacy (AOR = 2.77; 95% CI, 2.63–2.93), and excessive polypharmacy (AOR = 2.48; 95% CI, 2.25–2.73). The presence of mental health conditions was independently associated with the number of prescription medications (IRR = 3.08; 95% CI, 2.92–3.25) and the odds of polypharmacy (AOR = 4.61; 95% CI, 3.84–5.53). Low SES showed an inverse relationship with the number of prescription medications (SEIFA1: IRR = 1.33; 95% CI, 1.11–1.59). We observed significant interactions between physical and mental health conditions, but the absolute difference was small.

Work productivity. An increased number of physical health conditions coupled with the presence of mental health conditions and low SES were associated with decreased work productivity (Table 3). For example, the AOR of labor force participation decreased as the number of physical health conditions increased (AOR = 0.71; 95% CI, 0.69–0.74). An increasing number of physical conditions was associated with retirement at a younger age (Coeff = −0.16; 95% CI, −0.25 to −0.07). The mean number of sick leave days taken increased with an increase in the number of physical health conditions (IRR = 1.24; 95% CI, 0.18–1.30). Low SES was also associated with loss of work productivity according to the lower probability of labor force participation and the increasing number of sick leave days taken observed in the lowest SES group. Reporting a mental health condition had no significant association with retirement age but was associated with a low participation in the labor force (AOR = 0.62; 95% CI, 0.57–0.68) and an increasing number of sick leave days taken (IRR = 1.45; 95% CI, 1.27–1.64).

Health-related quality of life. For each increase in the number of physical health conditions, a substantial reduction in SF-6D scores (Coeff = −0.03; 95% CI, −0.03 to −0.03 of the total scale of 1) occurred (Table 4). Regardless of the number of physical health conditions, reporting a mental health condition decreased HRQoL (Coeff = −0.1; 95% CI, −0.1 to −0.09). The association between SES and SF-6D score showed that the low SES group had low HRQoL (SEIFA1: Coeff = −0.02; 95% CI, −0.03 to −0.02).

Sensitivity analyses. Changing mental health condition to "depression/anxiety" did not substantially change the results; however, when the same exposure was changed to "other mental illnesses," the estimated coefficient was slightly larger in the models for the number of nights in hospital (IRR = 10.7; 95% CI, 7.27–15.7), polypharmacy (AOR = 6.95; 95% CI, 4.89–9.86), and labor force participation (AOR = 0.34; 95% CI, 0.28–0.41). In general, the results did not substantially change when we used balanced samples instead of unbalanced samples.

Discussion

Ours was the first study to use nationally representative data from Australia to examine how physical multimorbidity coupled with a mental health condition is associated with use of health services, work productivity, and HRQoL in relation to low socioeconomic status. Physical multimorbidity and mental health condition were shown to be positively associated at baseline, and also over time (adjusting for age). The reasons why the risk of developing physical multimorbidity is higher over time in the absence of a mental health condition at baseline (and vice versa) may be because people with either physical multimorbidity or a mental health condition are more engaged with health services than those without these conditions. However, we could not confirm this by the modelling approach we used.

We found that physical multimorbidity was associated with increased use of health services and prescription medications, reduced work productivity, and reduced HRQoL. Our study showed that the presence of mental health conditions and low socioeconomic status exacerbated these effects after adjusting for covariates. Collectively, our results suggest that people with the most physical health conditions and mental health conditions in the lowest SES group used the most health services, had the lowest work productivity, and had the lowest HRQoL.

Our study had limitations. The data we collected on physical and mental health conditions were based on self-reported medical history, which may not accurately reflect health status and was likely under-reported, particularly by people from low socioeconomic backgrounds (19,20). Self-reporting of health service use and sick leave days taken in the past 12 months was prone to recall error. The GP visits, overnight stays in hospital, and work productivity loss resulting from sickness that we assessed in our study were not specific to chronic physical health conditions or mental health conditions alone and could have included acute conditions. Pa-

tients with severe illness may have been less likely to participate in the survey; therefore, the prevalence and outcomes reported in our study might be underestimated. We used a simple count of physical health conditions to determine multimorbidity and a dichotomous variable for the presence of a mental health condition; therefore, we were not able to account for disease severity. In addition, respondents were asked if they had "depression or anxiety" or "other mental illness" in the HILDA Survey; therefore, we were not able to analyze specific mental health conditions. Furthermore, we used SEIFA as an indicator of SES, which is an index for geographic areas, and might not be a true estimation of individual SES. Finally, we assessed the trajectory of a combined physical multimorbidity and a mental health condition over time, which accounted for a relevant health condition from baseline data (wave 9) but did not account for time-varying exposure after that. Also, our analysis excluded observations with missing data and only accounted for those with complete data.

Our study provides the first comprehensive analysis to consider all types of costs (ie, direct, indirect, and intangible costs) associated with physical and mental multimorbidity by using a large sample nationally representative of Australia. To our knowledge, only 3 studies — from Canada (21), Scotland (22), and France (23) — assessed the joint effect of physical multimorbidity and mental health conditions. Despite differences in the methodologies, our findings were consistent with those results in previous studies indicating that the presence of a mental health condition increased the association between physical multimorbidity and health service use and HRQoL.

Our study contributes to the growing evidence base that multimorbidity is associated with a greater social and financial burden on individuals, especially when they also have a mental health condition. Our findings are consistent with those of previous local studies in Australia and Europe that concluded that multimorbidity places a substantial burden on health service use (24–26). Current health care is based on single-disease–specific care rather than patient-centered care, which takes into account multimorbidity. As a result, clinical care becomes more complex for patients with multiple diseases, as our finding of greater use of health services and polypharmacy for people with multimorbidity illustrates. Therefore, updating clinical guidelines to reflect patient-centered care and multimorbidity, rather than the current single-disease focus, is warranted (27). Very little evidence exists in the literature on the impact of multimorbidity on loss of work productivity. Consistent with our findings, a US study based on a sample from employed nonelderly adults found that multimorbidity was associated with loss of work productivity (28). Our findings on work productivity indicate employees presenting with multimorbidity may have reduced employment prospects, because they are likely to experience difficulties in staying at work or returning to work while using health services and maintaining their health conditions. The cumulative effect of multimorbidity poses further financial burdens on patients with multimorbidity, particularly for those with low SES, who are more likely to have both physical and mental multimorbidity. Furthermore, our study on HRQoL is consistent with a Southern Australian study that found multimorbidity was associated with a lower HRQoL (29).

Our study provides further evidence that suggests targeted policies and interventions should be considered to tackle the growing burden of physical and mental multimorbidity. Despite the growing prevalence of physical and mental multimorbidity, most clinical practice and preventive strategies throughout the world to date emphasize improving identification and management of a single chronic condition (30). Our findings suggest more focus should be placed on treating patients with multimorbidity with a more patient-centered approach that fosters integrated treatment of physical and mental health conditions. It is worth noting that in Australia, patients living in low SES areas tend to receive poorer quality of care than those living in more affluent areas (31). Decisive action is needed to improve the management of chronic conditions for people in low SES areas in order to mitigate socioeconomic inequalities in health and health care.

Our findings support the earlier finding of a negative association between work productivity and multimorbidity (28). Work management plans for employees with multimorbidity that allow flexible work time and workplace adaptation should be considered. Such plans will ensure that patients can get treatment while working and can return to work after long-term leave. Our findings of increased health service costs and lowered work productivity raise the need for health financing policies to alleviate financial burdens amongst people with multimorbidity. Initiatives such as reduced cost-sharing could also be considered. In Australia, this could be achieved by extending the criteria for receiving Australia's Health Care Card that provides access to reduced costs on medicines, or by considering increasing rebates via the personal income tax. Future research is needed to examine in more detail the impoverishing effect of physical and mental multimorbidity in order to develop suitable policies that protect the health and socioeconomic well-being of people with multimorbidity.

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Tables

Table 1. Longitudinal Association Between Physical Multimorbidity and Mental Health Condition, HILDA Survey[a], Australia, 2009, 2013, 2017

Characteristic	Physical Multimorbidity	Mental Health Condition
	AOR (95% CI)	AOR (95% CI)
Mental health condition (at baseline)	3.44 (3.00–3.95)	NA
Physical multimorbidity (at baseline)	NA	3.10 (2.73–3.53)
Time (years from baseline)		
No mental health condition	1.08 (1.07–1.09)	NA
Mental health condition	1.02 (1.00–1.04)	NA
No physical multimorbidity	NA	1.08 (1.07–1.09)
Physical multimorbidity	NA	1.02 (1.01–1.04)
Socioeconomic indexes for areas[b]		
5		Reference
4	1.04 (0.93–1.17)	1.1 (0.99–1.21)
3	1.3 (1.16–1.47)	1.25 (1.13–1.38)
2	1.36 (1.21–1.53)	1.34 (1.22–1.48)
1	1.66 (1.47–1.86)	1.54 (1.39–1.69)
Sex		
Male		Reference
Female	1.11 (1.02–1.19)	1.7 (1.59–1.82)
Baseline age (in years)	1.09 (1.08–1.09)	0.99 (0.99–0.99)
Education level[c]		
Low		Reference
Middle	0.84 (0.77–0.92)	1.03 (0.96–1.10)
High	0.64 (0.58–0.72)	0.8 (0.73–0.88)
Indigenous status		
Non-Indigenous Australian		Reference
Indigenous Australian	1.73 (1.40–2.14)	1.38 (1.18–1.62)
Country of birth		
Australia		Reference
Other English-speaking country (United Kingdom, New Zealand, Canada, United States, Ireland, or South Africa)	0.93 (0.83–1.05)	1.0 (0.89–1.14)
Other	0.89 (0.80–1.00)	0.68 (0.61–0.77)
Marital status		

Abbreviations: AOR, adjusted odds ratio; HILDA, Household, Income and Labour Dynamics in Australia Survey.

[a] A nationally representative longitudinal survey that collects key information on economic and personal well-being, labor market dynamics, and family life in Australian households among individuals aged 15 years or over (16).

[b] Scale of 1 to 5 with 5 the highest. Socio Economic Indexes for Areas (SEIFA) is an index that ranks geographic areas across Australia according to relative socioeconomic advantage and disadvantage. SEIFA was created on the basis of 2011 social and economic census information (18).

[c] Low level (year 11 and below), middle level (year 12, certificate or , diploma, advanced diploma), high level (bachelor or honors, graduate diploma, graduate certificate, post graduate).

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(continued)

Table 1. Longitudinal Association Between Physical Multimorbidity and Mental Health Condition, HILDA Survey[a], Australia, 2009, 2013, 2017

Characteristic	Physical Multimorbidity AOR (95% CI)	Mental Health Condition AOR (95% CI)
Married/de facto		Reference
Single, separated, divorced, widowed	0.99 (0.92–1.07)	1.28 (1.21–1.37)
State		
New South Wales		Reference
Victoria	0.88 (0.80–0.98)	1.13 (1.04–1.24)
Queensland	0.94 (0.85–1.05)	1.02 (0.93–1.11)
South Australia	1.09 (0.95–1.25)	1.14 (1.01–1.29)
Western Australia	0.91 (0.79–1.05)	1.14 (1.01–1.29)
Tasmania	1.16 (0.95–1.42)	1.2 (1.01–1.42)
Northern Territory	0.72 (0.43–1.20)	0.79 (0.55–1.13)
Australian Capital Territory	1.08 (0.80–1.46)	1.17 (0.93–1.47)
Area		
Urban		Reference
Rural	1.01 (0.92–1.11)	0.94 (0.86–1.02)

Abbreviations: AOR, adjusted odds ratio; HILDA, Household, Income and Labour Dynamics in Australia Survey.
[a] A nationally representative longitudinal survey that collects key information on economic and personal well-being, labor market dynamics, and family life in Australian households among individuals aged 15 years or over (16).
[b] Scale of 1 to 5 with 5 the highest. Socio Economic Indexes for Areas (SEIFA) is an index that ranks geographic areas across Australia according to relative socioeconomic advantage and disadvantage. SEIFA was created on the basis of 2011 social and economic census information (18).
[c] Low level (year 11 and below), middle level (year 12, certificate or , diploma, advanced diploma), high level (bachelor or honors, graduate diploma, graduate certificate, post graduate).

Table 2. Effect of the Association Between Physical Multimorbidity, Mental Health Conditions, and Socioeconomic Status on Health Service Use, HILDA Survey[a], Australia, 2009, 2013, 2017

Characteristic	Number of GP Visits, IRR (95% CI)[b]	Number of Nights at Hospital, IRR (95% CI)[b]	Number of Prescription Medications, IRR (95% CI)[b]	Polypharmacy, AOR (95% CI)[c]	Excessive Polypharmacy, AOR (95% CI)[d]
Physical multimorbidity	1.41 (1.39–1.43)	1.77 (1.68–1.87)	1.75 (1.72–1.78)	2.77 (2.63–2.93)	2.48 (2.25–2.73)
Mental health condition	2.11 (2.03–2.20)	3.59 (2.93–4.41)	3.08 (2.92–3.25)	4.61 (3.84–5.53)	3.69 (2.46–5.53)
Physical health conditions × mental health conditions[e]	0.86 (0.84–0.88)	0.71 (0.65–0.78)	0.73 (0.71–0.75)	0.8 (0.73–0.87)	0.86 (0.76–0.98)
Survey wave					
9, 2009, n = 13,284					Reference
13, 2013, n = 17 459	0.99 (0.97–1.02)	1.05 (0.92–1.19)			Reference
17, 2017, n = 17,527	0.99 (0.96–1.01)	1.08 (0.95–1.23)	1.06 (1.04–1.09)	1.14 (1.05–1.23)	1.06 (0.89, 1.26)
Socioeconomic indexes for areas[f]					
5					Reference
4	1.05 (1.01–1.09)	0.96 (0.81–1.14)	1 (0.94–1.05)	0.99 (0.82–1.19)	0.89 (0.58–1.37)
3	1.08 (1.04–1.13)	1.27 (1.06–1.52)	1.02 (0.97–1.08)	1.11 (0.92–1.33)	0.9 (0.60, 1.36)
2	1.18 (1.13–1.22)	1.14 (0.96–1.36)	1.11 (1.05–1.17)	1.32 (1.11–1.58)	1.3 (0.88–1.93)
1	1.23 (1.19–1.29)	1.37 (1.13–1.67)	1.12 (1.05–1.18)	1.33 (1.11–1.59)	1.37 (0.93–2.01)
Sex					
Male					Reference
Female	1.41 (1.38–1.45)	1.22 (1.08–1.37)	1.2 (1.16–1.24)	0.83 (0.74–0.92)	0.78 (0.62–0.97)
Age	1 (1.00–1.00)	1.02 (1.01–1.02)	1.03 (1.03–1.03)	1.06 (1.05–1.06)	1.04 (1.04–1.05)
Education[g]					
Low					Reference
Middle	1 (0.97–1.03)	0.95 (0.83–1.09)	0.98 (0.94–1.02)	0.84 (0.75–0.95)	0.87 (0.68–1.10)
High	0.88 (0.85–0.91)	0.91 (0.77–1.06)	0.95 (0.90–1.00)	0.66 (0.56–0.78)	0.68 (0.47–1.00)
Indigenous status					
Non-Indigenous Australian					Reference
Indigenous Australian	1.11 (1.02–1.20)	1.67 (1.19–2.34)	1.01 (0.91–1.11)	1.32 (0.97–1.79)	1.03 (0.56–1.90)
Country of birth					
Australia					Reference

Abbreviations: AOR, adjusted odds ratio; GP, general practitioner; HILDA, Household, Income and Labour Dynamics in Australia Survey; IRR, incidence rate ratio; NA, not applicable.

[a] A nationally representative longitudinal survey that collects key information on economic and personal well-being, labor market dynamics, and family life in Australian households among individuals aged 15 years or over (16).

[b] Number of GP visits, nights at hospital, and prescription medications calculated by using generalized estimating equations with negative binomial family.

[c] Taking 5 or more prescription medications, calculated by using generalized estimating equations with binomial family.

[d] Taking 10 or more prescription medications, calculated by using generalized estimating equations with binomial family.

[e] Physical and mental condition interaction: number of physical conditions and the presence of mental health conditions (binary).

[f] Scale of 1 to 5 with 5 the highest. Socio Economic Indexes for Areas (SEIFA) is an index that ranks geographic areas across Australia according to relative socioeconomic advantage and disadvantage. SEIFA was created on the basis of 2011 social and economic census information.

[g] Low level (year11 and below), middle level (year 12, certificate or , diploma, advanced diploma), high level (bachelor or honors, graduate diploma, graduate certificate, post graduate).

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Table 2. Effect of the Association Between Physical Multimorbidity, Mental Health Conditions, and Socioeconomic Status on Health Service Use, HILDA Survey[a], Australia, 2009, 2013, 2017

Characteristic	Number of GP Visits, IRR (95% CI)[b]	Number of Nights at Hospital, IRR (95% CI)[b]	Number of Prescription Medications, IRR (95% CI)[b]	Polypharmacy, AOR (95% CI)[c]	Excessive Polypharmacy, AOR (95% CI)[d]
Other English-speaking country (United Kingdom, New Zealand, Canada, United States, Ireland, or South Africa)	0.96 (0.91–1.00)	0.82 (0.68–0.98)	0.94 (0.89–0.99)	0.99 (0.84–1.16)	0.99 (0.72–1.36)
All others	1.06 (1.02–1.11)	0.82 (0.65–1.04)	0.82 (0.78–0.86)	0.83 (0.71–0.98)	0.7 (0.50–0.99)
Marital status					
Married/cohabiting					Reference
Single, separated, divorced, or widowed	1.0 (0.97–1.02)	1.24 (1.10–1.39)	1.03 (1.00–1.07)	1.07 (0.96–1.20)	1.34 (1.08–1.66)
State					
New South Wales					Reference
Victoria	1.03 (0.99–1.06)	0.97 (0.82–1.14)	1.01 (0.97–1.06)	1.07 (0.93–1.24)	1.2 (0.89–1.62)
Queensland	1.02 (0.98–1.05)	1.03 (0.88–1.20)	1.03 (0.98–1.08)	1.13 (0.97–1.31)	1.36 (1.01–1.83)
South Australia	1.0 (0.95–1.05)	0.95 (0.78–1.16)	1.08 (1.02–1.15)	1.24 (1.02–1.50)	1.47 (1.02–2.11)
Western Australia	0.95 (0.91–1.00)	0.99 (0.81–1.21)	1.06 (0.99–1.13)	1.18 (0.96–1.44)	1.27 (0.86–1.89)
Tasmania	0.96 (0.89–1.04)	0.77 (0.60–0.99)	1.05 (0.96–1.16)	0.92 (0.67–1.26)	0.85 (0.47–1.53)
Northern Territory	0.88 (0.76–1.01)	1.14 (0.74–1.76)	0.95 (0.73–1.23)	0.71 (0.27–1.90)	NA
Australian Capital Territory	0.96 (0.88–1.05)	1.03 (0.68–1.55)	0.96 (0.84–1.09)	0.97 (0.62–1.51)	1.67 (0.67–4.18)
Area					
Urban					Reference
Rural	0.95 (0.91–0.99)	1.01 (0.86–1.18)	0.97 (0.93–1.02)	0.97 (0.84–1.13)	0.88 (0.64–1.22)

Abbreviations: AOR, adjusted odds ratio; GP, general practitioner; HILDA, Household, Income and Labour Dynamics in Australia Survey; IRR, incidence rate ratio; NA, not applicable.

[a] A nationally representative longitudinal survey that collects key information on economic and personal well-being, labor market dynamics, and family life in Australian households among individuals aged 15 years or over (16).

[b] Number of GP visits, nights at hospital, and prescription medications calculated by using generalized estimating equations with negative binomial family.

[c] Taking 5 or more prescription medications, calculated by using generalized estimating equations with binomial family.

[d] Taking 10 or more prescription medications, calculated by using generalized estimating equations with binomial family.

[e] Physical and mental condition interaction: number of physical conditions and the presence of mental health conditions (binary).

[f] Scale of 1 to 5 with 5 the highest. Socio Economic Indexes for Areas (SEIFA) is an index that ranks geographic areas across Australia according to relative socioeconomic advantage and disadvantage. SEIFA was created on the basis of 2011 social and economic census information.

[g] Low level (year11 and below), middle level (year 12, certificate or , diploma, advanced diploma), high level (bachelor or honors, graduate diploma, graduate certificate, post graduate).

Table 3. Effect of the Association Between Physical Multimorbidity, Mental Health Conditions, and Socioeconomic Status on Work Productivity, HILDA Survey[a], Australia, 2009, 2013, 2017

Characteristic	Labor Force Participation, AOR (95% CI)[b]	Retirement Age, Coeff (95% CI)[c]	Number of Sick Leave Days Taken, IRR (95%CI)[d]
Physical multimorbidity	0.71 (0.69 to 0.74)	−0.16 (−0.25 to 0.07)	1.24 (1.18 to 1.30)
Mental health condition	0.62 (0.57 to 0.68)	−0.35 (−0.85 to 0.14)	1.45 (1.27 to 1.64)
Physical health conditions × mental health conditions[e]	0.93 (0.87 to 0.99)	0.05 (−0.20 to 0.30)	0.86 (0.75 to 0.98)
Survey wave no.			
9, 2009, n = 13, 284			Reference
13, 2013, n = 17, 459	0.85 (0.80 to 0.89)	0.87 (0.55 to 1.20)	0.96 (0.90 to 1.02)
17, 2017, n = 17,527	0.88 (0.83 to 0.93)	1.2 (0.86 to 1.54)	1 (0.94 to 1.07)
Socioeconomic indexes for areas[f]			
5			Reference
4	1.22 (1.11 to 1.34)	−0.03 (−0.55 to 0.49)	1.05 (0.96 to 1.14)
3	1.07 (0.98 to 1.18)	0.02 (−0.49 to 0.53)	1.07 (0.98 to 1.16)
2	0.94 (0.86 to 1.03)	−0.33 (−0.84 to 0.17)	1.13 (1.04 to 1.23)
1	0.76 (0.69 to 0.83)	−0.1 (−0.61 to 0.41)	1.17 (1.07 to 1.28)
Sex			
Male			Reference
Female	0.53 (0.49 to 0.56)	−4.77 (−5.43 to −4.12)	1.17 (1.11 to 1.23)
Age	0.99 (0.98 to 0.99)	0.1 (0.07 to 0.14)	1.01 (1.00 to 1.01)
Education[g]			
Low education			Reference
Middle education	2.65 (2.48 to 2.84)	2.83 (2.09 to 3.57)	1.42 (1.31 to 1.53)
High education	4.23 (3.85 to 4.65)	5.72 (4.85 to 6.59)	1.61 (1.47 to 1.77)
Indigenous status			
Non-Indigenous Australian			Reference
Indigenous Australian	0.57 (0.49 to 0.66)	−1.28 (−4.85 to 2.29)	1.24 (1.07 to 1.44)
Country of birth			
Australia			Reference
Other English-speaking country (United Kingdom, New Zealand, Canada, United States, Ireland, or South Africa)	0.97 (0.86 to 1.09)	1.07 (0.23 to 1.90)	0.94 (0.83 to 1.07)
All others	0.59 (0.53 to 0.65)	−0.36 (−1.24 to 0.51)	0.83 (0.76 to 0.91)

Abbreviations: AOR, adjusted odds ratio; HILDA, Household, Income and Labour Dynamics in Australia Survey; IRR, incidence rate ratio; NA, not applicable.
[a] A nationally representative longitudinal survey that collects key information on economic and personal well-being, labor market dynamics, and family life in Australian households among individuals aged 15 years or over (16).
[b] Respondents aged ≤65 who participated in the labor force, calculated by using generalized estimating equations with binomial family.
[c] Respondents aged ≥65 who were retired from the labor force, calculated by using generalized estimating equations with Gaussian family.
[d] Calculated by using generalized estimating equations with Gaussian family.
[e] Physical and mental condition interaction: number of physical conditions and the presence of mental health conditions (binary).
[f] Scale of 1 to 5 with 5 the highest. Socio Economic Indexes for Areas (SEIFA)is an index that ranks geographic areas across Australia according to relative socioeconomic advantage and disadvantage. SEIFA is based on 2011 social and economic census information (18).
[g] Low level (year 11 and below), middle level (year 12, certificate or , diploma, advanced diploma), high level (bachelor or honors, graduate diploma, graduate certificate, post graduate).

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Table 3. Effect of the Association Between Physical Multimorbidity, Mental Health Conditions, and Socioeconomic Status on Work Productivity, HILDA Survey[a], Australia, 2009, 2013, 2017

Characteristic	Labor Force Participation, AOR (95% CI)[b]	Retirement Age, Coeff (95% CI)[c]	Number of Sick Leave Days Taken, IRR (95%CI)[d]
Marital status			
Married/living together			Reference
Single, separated, divorced, or widowed	0.71 (0.67 to 0.75)	−0.33 (−0.71 to 0.05)	0.8 (0.76 to 0.86)
State			
New South Wales			Reference
Victoria	1.08 (1.00 to 1.17)	0.27 (−0.50 to 1.03)	1.04 (0.97 to 1.13)
Queensland	1.13 (1.04 to 1.23)	−0.08 (−0.81 to 0.66)	0.98 (0.91 to 1.06)
South Australia	1.07 (0.95 to 1.19)	−0.17 (−1.21 to 0.87)	1.03 (0.91 to 1.17)
Western Australia	1.12 (0.99 to 1.26)	0.93 (−0.13 to 1.99)	0.99 (0.89 to 1.11)
Tasmania	1.28 (1.07 to 1.52)	−0.03 (−1.47 to 1.41)	1.03 (0.88 to 1.21)
Northern Territory	2.74 (1.67 to 4.47)	−4.2 (−13.99 to 5.58)	1.44 (1.13 to 1.84)
Australian Capital Territory	1.23 (0.96 to 1.57)	NA	1.51 (1.30 to 1.76)
Area			
Urban			Reference
Rural	0.87 (0.80 to 0.95)	0.54 (0.03 to 1.06)	0.8 (0.71 to 0.90)

Abbreviations: AOR, adjusted odds ratio; HILDA, Household, Income and Labour Dynamics in Australia Survey; IRR, incidence rate ratio; NA, not applicable.
[a] A nationally representative longitudinal survey that collects key information on economic and personal well-being, labor market dynamics, and family life in Australian households among individuals aged 15 years or over (16).
[b] Respondents aged ≤65 who participated in the labor force, calculated by using generalized estimating equations with binomial family.
[c] Respondents aged ≥65 who were retired from the labor force, calculated by using generalized estimating equations with Gaussian family.
[d] Calculated by using generalized estimating equations with Gaussian family.
[e] Physical and mental condition interaction: number of physical conditions and the presence of mental health conditions (binary).
[f] Scale of 1 to 5 with 5 the highest. Socio Economic Indexes for Areas (SEIFA)is an index that ranks geographic areas across Australia according to relative socioeconomic advantage and disadvantage. SEIFA is based on 2011 social and economic census information (18).
[g] Low level (year 11 and below), middle level (year 12, certificate or , diploma, advanced diploma), high level (bachelor or honors, graduate diploma, graduate certificate, post graduate).

Table 4. Effects of Association Between Physical Multimorbidity, Mental Health Conditions, and Socioeconomic Status on Health-Related Quality of Life, HILDA Survey[a], Australia, 2009, 2013, 2017

Characteristic	SF-6D[b] Coefficient (95% CI)[c]
Physical multimorbidity	−0.03 (−0.03 to −0.03)
Mental health condition	−0.1 (−0.10 to−0.09)
Physical health conditions × mental health conditions[d]	0 (0.00 to 0.01)
Survey wave no.	
9, 2009, N = 13,284	Reference
13, 2013, N = 17,459	−0.01 (−0.01 to −0.00)
17, 2017, N = 17,527	−0.01 (−0.01 to −0.01)
Socioeconomic indexes for areas[e]	
5	Reference
4	−0.01 (−0.01 to −0.00)
3	−0.01 (−0.01 to −0.01)
2	−0.02 (−0.02 to −0.01)
1	−0.02 (−0.03 to −0.02)
Sex	
Male	Reference
Female	−0.01 (−0.02 to −0.01)
Age	0 (−0.00 to −0.00)
Education[f]	
Low education	Reference
Middle education	0.01 ((0.00 to 0.01)
High education	0.02 ((0.01 to 0.02)
Indigenous status	
Non-Indigenous Australian	Reference
Indigenous Australian	−0.02 (−0.03 to −0.01)
Country of birth	
Australia	Reference
Other English-speaking countries (United Kingdom, New Zealand, Canada, United States, Ireland, or South Africa)	0 (−0.00 to 0.01)

Abbreviation: HILDA, Household, Income and Labour Dynamics in Australia Survey.
[a] A nationally representative longitudinal survey that collects key information on economic and personal well-being, labor market dynamics, and family life in Australian households among individuals aged 15 years or over (16).
[b] SF-6D is 11 questions from the SF-36 (the short form of the Health Status Questionnaire) used to define the 6 domains of health-related quality of life (physical functioning, role limitation, social functioning, pain, mental health, and vitality) (17). Calculated by using generalized estimating equations with Gaussian family.
[c] Coefficient was calculated from multivariable linear regression model.
[d] Physical and mental condition interaction: number of physical condition and the presence of mental health conditions (binary).
[e] Scale of 1 to 5 with 5 the highest. Socio Economic Indexes for Areas (SEIFA) is an index that ranks geographic areas across Australia according to relative socioeconomic advantage and disadvantage. SEIFA is based on 2011 social and economic census information (18).
[f] Low level (year 11 and below), middle level (year 12, certificate or , diploma, advanced diploma), high level (bachelor or honors, graduate diploma, graduate certificate, post graduate).

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Table 4. Effects of Association Between Physical Multimorbidity, Mental Health Conditions, and Socioeconomic Status on Health-Related Quality of Life, HILDA Survey[a], Australia, 2009, 2013, 2017

Characteristic	SF-6D[b] Coefficient (95% CI)[c]
All others	−0.02 (−0.02 to −0.01)
Marital status	
Married/cohabiting	Reference
Single, separated, divorced, or widowed	−0.01 (−0.02 to −0.01)
State	
New South Wales	Reference
Victoria	0 (−0.00 to 0.00)
Queensland	0 (−0.01 to −0.00)
South Australia	−0.01 (−0.01 to −0.00)
Western Australia	0 (−0.01 to 0.00)
Tasmania	0.01 (−0.00 to 0.01)
Northern Territory	0 (−0.02 to 0.01)
Australian Capital Territory	−0.01 (−0.01 to 0.00)
Area	
Urban	Reference
Rural	0 (−0.00 to 0.00)

Abbreviation: HILDA, Household, Income and Labour Dynamics in Australia Survey.
[a] A nationally representative longitudinal survey that collects key information on economic and personal well-being, labor market dynamics, and family life in Australian households among individuals aged 15 years or over (16).
[b] SF-6D is 11 questions from the SF-36 (the short form of the Health Status Questionnaire) used to define the 6 domains of health-related quality of life (physical functioning, role limitation, social functioning, pain, mental health, and vitality) (17). Calculated by using generalized estimating equations with Gaussian family.
[c] Coefficient was calculated from multivariable linear regression model.
[d] Physical and mental condition interaction: number of physical condition and the presence of mental health conditions (binary).
[e] Scale of 1 to 5 with 5 the highest. Socio Economic Indexes for Areas (SEIFA) is an index that ranks geographic areas across Australia according to relative socioeconomic advantage and disadvantage. SEIFA is based on 2011 social and economic census information (18).
[f] Low level (year 11 and below), middle level (year 12, certificate or , diploma, advanced diploma), high level (bachelor or honors, graduate diploma, graduate certificate, post graduate).

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COMMENTARY

Recommendations for Keeping Parks and Green Space Accessible for Mental and Physical Health During COVID-19 and Other Pandemics

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PEER REVIEWED

Summary

What is already known on this topic?

Engaging in regular physical activity and having access to nature or green space are beneficial for physical and mental health.

What is added by this report?

Shelter-in-place and safer-at-home orders limit access to parks and green space for many people. We propose some short- and long-term solutions that can provide access to green space, while allowing for physical distancing.

What are the implications for public health practice?

These solutions may be useful and informative for cities, states, and countries around the globe as they implement policies to address the coronavirus disease 2019 pandemic, which can lead to healthier communities and populations.

Abstract

The importance of engaging in any type of physical activity regularly, for both physical and mental health, is well established, and may be particularly beneficial in protecting the body and limiting the damage caused by the coronavirus disease 2019 (COVID-19). Exposure to nature or green space also has positive physical and mental health benefits. Closures of parks and green spaces during the COVID-19 pandemic has limited the options for physical activity and may affect vulnerable populations more than others. We provide both short-term and long-term recommendations to encourage access to green space for people while allowing for physical distancing.

Introduction

The importance of engaging in any type of physical activity regularly, including exercising for both physical and mental health, is well established and, more important, may be particularly beneficial in protecting the body and limiting the damage caused by the coronavirus disease 2019 (COVID-19) (1). Engaging in regular physical activity is also protective against poor cardiovascular health, obesity, hypertension, and diabetes, which are shown as risk factors for COVID-19 (1). Exposure to nature or green space also has positive physical and mental health benefits, including lower rates of heart disease, stroke, obesity, stress, and depression (2). In fact, exposure to green space, even in a limited setting (eg, residential city streets in urban areas), is just as beneficial for health as that of visiting a natural setting or large public park (3).

In March 2020, the majority of United States governors issued shelter-in-place orders (4). Collectively, these orders severely restricted movements of individuals across the nation (4). These orders resulted in the closure of primary, secondary, and postsecondary schools; local fitness, physical activity, and recreational facilities; sports clubs; and non-essential businesses. Yet public health entities, such as the American Public Health Association and the Centers for Disease Control and Prevention, have stressed the importance of staying physically active while sheltering in place during COVID-19, which includes visiting parks and green space (5). With the closure of schools, fitness facilities, and other community places for recreation, local streets, parks, trails, and open green spaces are the only places available for physical activity outside of the home environment (6). However, many public parks and green spaces were also closed because of concerns about social distancing, and most state and local shelter-in-place orders allow only limited use of parks and green space (6). For example, people may access parks and green space near their homes, but playgrounds and equipment, sports courts, and trails are likely closed to the public. These restrictions might contribute to increased adverse physical and mental health outcomes for a substantial portion of the population, particularly those in urban set-

tings, which, in turn, may be negatively associated with how well people can fight COVID-19 (1,7). The latest research shows that people must have sustained contact of 10 minutes or more (7) and be less than 6 feet (8) from others to be most susceptible to contracting COVID-19. If park, trail, and playground patrons remain appropriately physically distant, do not engage in lengthy conversations with nonhousehold members, and wear a protective face mask, their risk of contracting COVID-19 by exercising outdoors is low, making parks and green spaces safe places to be physically active during a pandemic (9). Being quarantined is associated with poor mental health outcomes (10), but maintaining access to parks and green space could counteract these negative effects.

Shelter-in-place orders limit physical activity options for everyone but have a greater effect on vulnerable populations (6). For example, racial minorities, such as African Americans, contract COVID-19 at higher rates than non-Hispanic whites and are disproportionately dying from the disease (11,12). These same populations tend to live in dense urban areas (13,14) with limited green space, and often in multiunit housing (11,12). Urban areas also have a greater likelihood of park deserts (ie, a defined geographic area that does not have a park present and accessible for use), or only small parks with limited features (15). These small parks are more likely to be restricted from public use during statewide shelter-in-place orders because of their size and might be dominated by play structures and banned from use (16). Communities lacking parks might need to explore alternative solutions for physical activity in outdoor public spaces. Urban and minority populations might also be reliant on public transit, which has been restricted to use for work or other essential needs (eg, purchasing groceries). Use of public transit for leisure activities (eg, visiting parks or other green spaces) is not recommended in many areas. Shelter-in-place orders might exacerbate inequities for people to access parks or green spaces if they do not live near them. Although the recommendations we provide can apply to a wide variety of populations in urban, suburban, and rural settings, they may be particularly relevant for minority populations in urban settings.

Recommended Strategies to Address Parks and Green Space Accessibility

A recent article highlights ways to be physically active in the home, but these recommendations lack suggestions regarding access to green space (17). Exercising at home might be adequate and feasible for certain segments of the population, but many people live in homes with limited space or other factors that negatively affect health. The relationship between housing conditions and health is well established (18). Although most states are partially or fully lifting shelter-in-place orders, maintaining some physical distancing (19) is recommended until a vaccine is developed or until adequate immunity is realized within the population. Reintroduction of shelter-in-place orders might be necessary in response to an increase in COVID-19 cases or for future communicable disease outbreaks.

In this commentary, we propose some solutions that can be implemented, now or in the future, to provide access to green space while allowing physical distancing. Our recommendations are not necessarily new or novel ideas. Several of the strategies and policy recommendations proposed here have been advocated for various public health sectors for more than a decade (20–24). The COVID-19 pandemic has highlighted these long-known deficiencies in walking, biking, and recreational infrastructure (25,26) that contribute to health disparities. We hope that some of the solutions we offer can be useful and informative for cities, states, and countries around the globe as they implement their own policies to address the COVID-19 pandemic. Ours is not a comprehensive list nor a list that can or should be implemented in all places; it is meant to be a starting point for a conversation between national, state, and local governments, parks and recreation departments, other nonprofit organizations (eg, National Recreation and Park Association, Trust for Public Land, sports leagues, philanthropic park partners), and researchers.

Short-Term Recommendations

Keep parks open

For both urban and rural areas, state and local parks with trails and open green space should remain open. Modifications in scheduling might be needed to help control the number of visitors at one time and allow for appropriate physical distancing.

- This could include structured schedules, time slots, or sign-up sheets either in person or online for smaller parks, or monitoring by park staff in larger parks.
- Staff from other departments may be needed to help ensure physical distancing guidance and that other rules are followed.
- Park visits and access to other green spaces could be proactively prioritized and formally organized for vulnerable populations.
- For parks with fees, fees could be adjusted on the basis of need. People who receive SNAP (Supplemental Nutrition Assistance Program) or Medicaid could have a reduced fee. Caution should be taken in terms of waiving fees for everyone as this might lead to a large increase in park visitation and crowding, as was seen in some parks early during the COVID-19 pandemic.
- Evaluate policies that change schedules and modify fees, to determine best practices in balancing expanded access with strategies to control the number of visitors.

Modify policies on the use of public transit

During shelter-in-place orders, maintain transit routes to parks and green

space. Allow riders to use transit to access parks and green space. Require public transit users to wear masks or face coverings and maintain physical distance. Public transit access to essential businesses and services (eg, healthcare facilities, grocery stores, and child care centers) must be balanced with access to parks and green space.

Adopt Open Streets or Slow Streets initiatives

Particularly in urban areas, such initiatives will allow closure of certain streets to vehicle traffic during specific days and times so that pedestrians and cyclists have more space to move. Some cities that have permanently adopted these initiatives could be evaluated to determine the impact of these initiatives (27). Streets with greenery, plants, or other natural features can be prioritized for these initiatives, given the positive association between public green space and mental health (28–30). To increase access to parks and green spaces, streets surrounding or connecting them could be designated as Open or Slow Streets.

Adopt consistent messaging

Consult communication resources for use of parks, such as the Centers for Disease Control and Prevention (https://www.cdc.gov/coronavirus/2019-ncov/daily-life-coping/visitors.html) (5) and the National Recreation and Park Association (https://www.nrpa.org/our-work/Three-Pillars/health-wellness/coronavirus-disease-2019/).

- Messages should be targeted to the specific population, especially vulnerable and marginalized populations. Consider messages in multiple languages and the use of pictograms or diagrams.
- Consideration should be given to the appropriate messengers and format for delivery.
- Emphasis should be placed on maintaining appropriate physical distancing, not social isolation (19).

Long-Term Recommendations

Create built environments for all users

Infrastructure plans should include policies and plans for creating healthy environments, such as Complete Streets, Safe Routes to Parks, Safe Routes to Schools, and mixed-use policies (20,24). Plans should also intentionally include green space and public spaces for leisure and recreation.

- Ensure that including green space is prioritized on streets in neighborhoods that lack them. Municipalities should review local design guidelines and zoning codes to ensure they include provisions for greenscapes, green streets, sidewalk planters, or other greening strategies.
- Consider access for all users through various approaches. Install protected bicycle lanes (ie, provide physical barriers between cars and bicyclists) or pedestrian connections to local trails, paths, parks, and green spaces. Increase parking for bicycles at parks and green spaces. Ensure public spaces comply with the Americans with Disabilities Act regulations. Engage with community members to explore availability, accessibility, and quality issues that are important to the community.
- Plan for maintenance and regular improvements of green spaces and parks.

Consider where to locate parks and green spaces

Ensure that quality parks and green spaces are located in close proximity to people, regardless of where they live.

Conduct ongoing monitoring and evaluation

To ensure that any strategies implemented work in the expected ways, plan for ongoing monitoring and evaluation. This should include examining any unintended consequences, such as decreased sanitary conditions, litter, substandard bathroom facilities, and increased crime.

- Evaluation should include the impact of strategies on mental and physical health.
- Create a national open platform for policy makers and researchers to share evidence-based strategies. Learning from the successes and mistakes of implementing these strategies is vital during this unprecedented situation.

These recommendations can apply to all settings, including rural main streets and suburban areas, but they might be particularly important for urban areas. We have highlighted several advantages to keeping parks open during a pandemic. Careful consideration of potential disadvantages is also essential. For example, with most public settings inaccessible, keeping parks and green space open could lead to overcrowding, making it difficult to maintain physical distance and resulting in increasing the spread of disease. Significant increases in park visitors could also add strains to local budgets and staff members (ie, maintenance and cleaning responsibilities might increase). Strains might also increase risk of illness or other unintended consequences to staff. Local communities might not have access to the resources needed to appropriately staff and maintain parks during a pandemic. Finally, less is known about how COVD-19 spreads in outdoor settings. The virus might be susceptible to sunlight (31). If COVID-19 transmission risk is lower outdoors, the efficacy of adhering to physical distancing guidelines (8) and avoiding prolonged close proximity to other people (7) might be increased. More studies are needed to evaluate the likelihood of contracting the disease while exercising outdoors.

Implications for Public Health

The COVID-19 pandemic has illuminated underlying disparities in access to parks and green space for underserved and vulnerable populations. Building a stronger infrastructure of neighborhood parks and green space throughout the country will help limit the impact of future public health disasters. Before and during a pandemic, national, state, and local policy makers, urban planners, and governments should thoughtfully consider what is appropriate

and important for overall population health and how best to implement some of the recommendations proposed while maintaining appropriate physical distancing in public spaces. Access to parks and green space is vitally important for the health and well-being of individuals, and it will lead to healthier populations.

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ORIGINAL RESEARCH

Association of Adult Depression With Educational Attainment, Aspirations, and Expectations

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PEER REVIEWED

Summary

What is already known on this topic?

Educational attainment is associated with depressive symptoms and may affect depression through various socioeconomic pathways. Education may offer opportunities for developing interventions to reduce the disease burden of depression.

What is added by this report?

We examined key factors in early childhood and adolescence often omitted as confounders of the relationship between adolescent educational aspirations and expectations and mental health outcomes in adulthood. We also looked at differences by sex and race/ethnicity.

What are the implications for public health practice?

Our findings suggest that the social forces that constrain education may also affect health. Additionally, our findings support other research that encourages health and education practitioners to acknowledge educational interventions as public health interventions.

Abstract

Introduction

Social factors across one's lifespan may contribute to the relationship between low educational attainment and depression, but this relationship has been understudied. Previous studies assessing the association between educational attainment and depression did not fully account for prior common determinants across the life course and possible interactions by sex or race/ethnicity. It is also unclear whether the link between educational attainment and depression is independent of the role of aspired educational attainment or expected educational attainment.

Methods

We used generalized linear log link models to examine the association between educational attainment at age 25 and depression at age 40 in the National Longitudinal Survey of Youth 1979 cohort, adjusting for confounders and mediators from childhood, adolescence, and adulthood.

Results

Members of each educational attainment group were less likely to be depressed at age 40 than those with less education. After adjusting for educational aspirations and educational expectations, the risk ratios became closer to the null. Neither sex nor race/ethnicity interacted with educational attainment. Additionally, low educational expectations in adolescence, but not low educational aspirations, was associated with a higher risk of depression at age 40.

Conclusion

Our study provides a nuanced understanding of the role of education, educational expectations, and educational aspirations as part of education's effect on risk of depression after controlling for a thorough set of confounders and mediators. Our findings may help advance the study of social determinants of depression.

Introduction

Depression, defined as a persistent feeling of sadness, is a leading cause of disability worldwide (1). Studying social determinant risk factors for depression can help identify effective interventions and reduce disease burden; education, in particular, offers many opportunities for intervention (2). Lower educational attainment is associated with increased risk of depressive symptoms (3,4). For monozygotic twins, having a college degree was associated with fewer depressive symptoms, suggesting this association may persist independent of other social and genetic factors (5).

Education may affect depression through various socioeconomic pathways. First, people with less schooling may have fewer eco-

nomic and social resources to address depressive episodes (6). Second, education affects socioeconomic position and people who ranked themselves lower in the social milieu, based in part on educational attainment, had higher odds of depression than those with higher social ranks (7). Third, education increases access to employment opportunities that are more creative, mentally stimulating, and involve higher autonomy, which also may affect mental well-being (8). These and other benefits of education for health and well-being can accumulate over one's life (8).

Our study sought to address some remaining key gaps in research on education and depression. We proposed a theoretical framework, weaving together the research literature with our hypotheses (Figure). First, existing research often omits key factors in early childhood and adolescence that could confound the association between education and depression, including parents' education, geographic location, and immigration (9,10). Additionally, socioeconomic factors during adulthood (eg, income, wealth, family size, marital status) likely mediate this association (8). Researchers must account for these factors to better understand the direct effect of education on depression and the indirect effects arising from adult socioeconomic position.

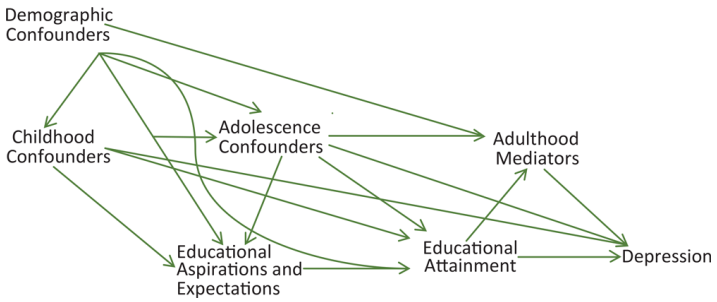

Figure. Theoretical framework consisting of hypothesized relationships between educational attainment, educational aspirations and expectations, depression in adulthood, and potential confounding and mediating variables.

Second, many studies do not assess potential effect measure modification. The theory of resource substitution posits that education is protective against disease for people with disadvantaged backgrounds (11). An inverse association between educational attainment and depression may be stronger in women than men, but few studies have assessed this association (12). Additionally, racial/ethnic variations are poorly understood. Some evidence suggests that education is inversely associated with depression for both white and black Americans (10). In another study, race/ethnicity and sex modified the association between educational attainment and mental health (13). Given this paucity of evidence, we investigated whether or not education–depression associations varied by sex or by race/ethnicity.

Third, most existing research fails to tease apart the dimensions of education that are dictated by individual determination versus external forces beyond individual control (14). These 2 different dimensions of education, operationalized as educational aspirations (individual determination) and educational expectations (external forces beyond one's control) could affect health differently (15). Educational aspirations, or the level of education a person wants to attain, reflect a mixture of traits (eg, personal motivation, self-esteem) that may propel a person to educational achievement. Educational expectations, the level of education a person anticipates attaining, represent underlying structural factors that influence achievement (eg, childhood socioeconomic position, parental support) (14). Adolescents with increased educational expectations have more capacity for seeking out economic and social resources essential to better physical and mental health (16), whereas those with unfulfilled expectations may have increased depressive symptoms (17) (although this may be fully explained by lower educational attainment [18]). However, little is known about how adolescent educational aspirations and expectations are associated with health outcomes during adulthood, particularly mental health.

The National Longitudinal Survey of Youth 1979 (NLSY79) Cohort (19) provides an opportunity to test 3 related hypotheses. First, previous studies of the association between educational attainment and depression may not have adjusted for all important social factors that were confounders. We hypothesized that educational attainment will be inversely associated with depression and that this association will be attenuated when we adjust for confounders and mediators from across the life course. Second, the association between educational attainment and depression is independent of any relationship between depression and educational aspirations and expectations. We hypothesized that the association between educational attainment and depression would be attenuated and possibly disappear after adjusting for educational aspirations and expectations. Third, past studies suggest that sex and race/ethnicity may modify the effect of the adjusted association between educational attainment and depression. We hypothesized that the association between educational attainment and depression may be stronger among women and may vary by race/ethnicity.

Methods

We used NLSY79 data, a cohort of people followed by the US Bureau of Labor Statistics and weighted to be nationally representative of Americans aged 14 to 21 in 1979. Participants in this age group were followed beginning in 1979 and completed surveys every 1 to 2 years thereafter. We used data through 2008; more sample details exist elsewhere (19). Briefly, we used a multistage stratified probability sampling approach to create a representative

sample of noninstitutionalized civilians aged 14 to 21 in 1979 and to oversample youth from underrepresented groups (Hispanic/Latino, black, economically disadvantaged whites). NLSY79 also developed weights to allow for nationally representative estimates (19). We restricted our sample to include youth with complete data for our variables of interest, leaving a final sample of 4,417. This sample consisted of 56.9% of NLSY79 participants who were followed through 2008 and 44.3% of the original sample, which is comparable to other longitudinal studies over a similar timespan (14). The study was deemed exempt by the University of California Berkeley Committee for the Protection of Human Subjects, because the data are publicly available and nonidentifiable.

Our outcome of interest was depressive symptoms at age 40, as measured by the Center for Epidemiologic Studies Depression Scale Short Form, a 7-item scale measuring frequency of depressive symptoms in the prior week (<1, 1–2, 3–4, or 5–7 days/week). The 7-item scale is similarly reliable and precise as the original longer version, with improved internal consistency (20). The scores of these 7 items were summed; the total score could range from 0 to 21. If any item was missing, the total score was coded as missing. A cutoff total score of ≥8 was used to create a dichotomous variable from the scale (20).

Explanatory variables were educational attainment, aspirations, and expectations. Educational attainment was the number of years of education attained by age 25; the US Census assumes people complete education by age 25. Number of years of education attained was reported at each interview. Educational aspirations and expectations were assessed in 1979 as the number of years of education participants aged 14 to 21 aspired to or expected to attain. The 3 educational variables were categorical, classified as having or aspiring to or expecting to attain less than a high school education (<12 years of school), high school graduation (12–15 years of school), or college graduation (≥16 years of school). Maternal and paternal educational attainment and the highest parental education variables were coded in the same categorical manner.

Models adjusted for sex and race/ethnicity (black, Hispanic, and non-Hispanic white). Asians (n = 142) were excluded from the sample because of the small sample size and missing data. Childhood and adolescent confounders were maternal and paternal education, highest education level of either parent, speaking a foreign language as a child, being born outside of the United States, living in the South (Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, or West Virginia), and living in an urban area as a child. Each of these variables could be associated with access to educational opportunities. Participant age in 1979 was included to account for any potential birth cohort differences. We also tested for effect measure modification by sex and race/ethnicity.

Potential mediators from adulthood were included to estimate direct versus indirect effects of education on depression. Individual and total family wealth (wealth = assets – debts) and income were measured continuously in standardized year-2000 dollar increments and were log-transformed. We also included family size, number of dependents, marital status, living in the South as an adult, and living in an urban area as an adult, all as measured at age 40.

We used generalized linear modeling with the log linear link function to calculate adjusted risk ratios (RRs) (21) in Stata 14.1 (StataCorp). We specified a Poisson distribution with robust standard errors, which does not require accurately specifying the distribution to calculate accurate point estimates and standard errors and avoids nonconvergence issues (22). *P* values were 2-sided and unadjusted for multiple comparisons (23). We did sensitivity analyses by re-running all our models in a multiply imputed dataset by using Stata's multiple imputation package. Five imputations of all education variables and confounders were conducted; our outcome, depression, was not imputed.

Results

Approximately 16.2% of the 4,417 study participants had depression at age 40 (Table 1). By age 25, 66.5% were high school graduates, 24.2% graduated from college, and 9.3% did not complete high school. Among those excluded from the analyses, there was a similar proportion of high school graduates (66.1%), fewer college graduates (17.4%), more with less than a high school education (16.4%), and a higher prevalence of depression (20.8%) than among those included in the sample. The sample was evenly divided by sex (51.5% female) and most of the sample (84.9%) was white; for those excluded from the sample, a smaller proportion were women and a larger proportion were nonwhite. Compared with participants categorized as not depressed, the depressed group in the sample had a higher proportion of women, had parents who were less educated, were less educated themselves, had lower educational aspirations and expectations, and had less wealth, income, and total family income. Fewer of the depressed group were married.

We found no effect measure modification by race/ethnicity (Wald test *P* value = .50) or sex (Wald test *P* value = .88) for associations between levels of educational attainment at age 25 and depression at age 40 (Table 2). In our unadjusted model, higher educational attainment was associated with a lower risk of depression. The point estimate did not change substantially when we added

child and adolescent confounders, although the childhood covariates still meaningfully contributed to the model (Wald *P* value < .005). Adding the hypothesized mediators attenuated the risk ratios. College graduates and high school graduates still had a lower risk of depression (adjusted RR = 0.73; 95% CI, 0.56–0.96) than those with less than a high school diploma (adjusted RR, 0.75; 95% CI, 0.62–0.91).

We assessed associations between adolescent educational aspirations and expectations and depression. Although adolescent educational aspirations were not associated with adult depression, lower adolescent educational expectations were. People who expected to be college graduates had a lower risk of depression than those who expected to be high school graduates (adjusted RR = 0.82; 95% CI, 0.68–0.98) and those who expected to attain less than a high school diploma (adjusted RR = 0.59; 95% CI, 0.44–0.79). Those who expected to be high school graduates had a lower risk than those who did not expect to graduate from high school (adjusted RR = 0.72; 95% CI, 0.56–0.93). When we had educational attainment, aspirations, and expectations in the same model, those with a college degree had a lower risk of depression than those with less than a high school diploma (adjusted RR = 0.62; 95% CI, 0.44–0.88), but all of the other RRs between education variables and depression were no longer significant.

The analyses using the multiply imputed dataset (Table 3) largely confirmed findings of the complete case analyses (Table 2). All associations that were significant at the *P* = .05 level in the complete case analyses remained so in multiply imputed analyses. However, some additional associations emerged when using the multiply imputed dataset because of the larger sample size. In particular, significant associations between educational aspirations and depression emerged: those who aspired to a college level education were less likely to be depressed, compared with those who aspired to high school graduation or less than high school graduation. Additionally, in the models of educational attainment and depression where educational aspirations and expectations were included as covariates, all measures of association (ie, college graduation vs high school graduation, college graduation vs less than high school graduation, high school graduation vs less than high school graduation) were significant.

Discussion

After considering a comprehensive set of socioeconomic measures across the life course and exploring different dimensions of the educational experience in a nationally representative US longitudinal cohort, we concluded that higher educational attainment and educational expectations, but not educational aspirations, are associated with reduced risk of depression at age 40. Findings regarding educational expectations suggest that the social forces that constrain education may also affect health. In the NLSY79 cohort, the educational attainment–depression association did not vary by race/ethnicity or sex. Our findings add to the body of research on education and depression (24), and concur that "shooting for the stars" with educational expectations is not detrimental (18).

Adult socioeconomic position (ie, household income, wealth, family size, number of dependents) appears to partially mediate the association between educational attainment and depression, consistent with prior research on poverty and depression (24). Even after accounting for this mediation, an educational attainment–depression association remained, potentially via empowerment (25), social connections (26), stress (27), or a variety of other factors (eg, health behaviors, adult socioeconomic position, health literacy) (2,13).

Our study had limitations. First, these data were self-reported and observational and therefore susceptible to human error; we assume that any such error is nondifferential. Second, our primary analysis was a complete case analysis, which assumes that all missing data are missing completely at random. However, our sensitivity analyses using multiple imputation reached the same conclusions. Additionally, the excluded population was relatively similar to the study sample by a variety of childhood, adolescent, and adult characteristics. Our use of the NLSY79's custom sampling weights also helped to counteract this limitation. Third, our generalizability is limited: almost 85% of participants in the NLSY79 sample were white. Although this was reflective of the population of adolescents in the United States in 1979, it is not reflective of the current US population. Fourth, we used the Baron and Kenny (28) approach to assess mediation, but other approaches to assess mediation also exist. Finally, we did not have a baseline measure of depression during adolescence, so we could not ascertain the incidence of depression. Therefore, we could only assess depression prevalence in adulthood, and could not know what depression began in adolescence or early adulthood, perhaps influencing educational attainment, expectations, or aspirations (ie, reverse causality or a more complex etiology). However, a systematic review of high school dropouts and mental health disorders suggested that depression is likely to be a result of low educational attainment rather than a cause of it (3).

Our study had several strengths. Our nationally representative, longitudinal cohort with detailed data across the life course, including multiple measures of socioeconomic position, allowed us to answer new and more nuanced questions related to the education–depression association. In particular, we had information about childhood socioeconomic position, which many other studies of adult mental health lack, and information about educational aspirations and expectations in adolescence, which are often not

included in other education–health studies focused on educational attainment. Additionally, including adult mediating factors in our final model, particularly various measurements of adult socioeconomic position, allowed us to parse out the direct effects of education from the indirect effects mediated by the adult socioeconomic consequences of education. We also used adjusted risk ratios, not odds ratios, to report our findings, because risk ratios are more intuitive to interpret, more conservative, and more appropriate for non-rare outcomes (21).

Future researchers should continue to assess the nuances of education as a health determinant (29), including the use of even more granular categories of educational attainment. Additionally, as Americans increasingly are involved in education throughout their lifespan, even after age 25, future investigations could track educational trajectories and examine if a different age cut-off may be more appropriate for completion of educational attainment or if education attained after age 25 has similar or different health benefits. Additionally, given how the racial/ethnic makeup of the US population has changed since this cohort was begun, we encourage future studies to replicate these analyses in more diverse populations and populations of color to help inform developing interventions to reduce depression risks in the current US population.

Our set of analyses builds on similar work focused on obesity (14), with relatively similar findings. We encourage future researchers to continue to explore the potential roles (or lack thereof) of educational aspirations, expectations, and attainment in relation to other health outcomes in adulthood. Given the likely importance of historical and societal contexts for the social patterning we observed (30), we also encourage researchers to explore whether these associations persist for other generations in the United States and in other countries. Our study focused on adolescent educational aspirations and educational expectations, because these are most immediately relevant for educational attainment in late adolescence and young adulthood (when we assume the majority of educational attainment occurs), but future researchers could also assess whether changes in educational aspirations and educational expectations over the life course could further nuance our understanding of these phenomena.

Our findings support other research indicating that health and education practitioners should acknowledge educational interventions as public health interventions, and work together (2,30). Future research could experimentally assess such educational interventions to explore how increasing educational attainment may affect mental health.

Higher educational attainment and expectations, even after adjusting for potential confounders and mediators from across the lifespan, are associated with reduced risk of depression in mid-life in a nationally representative sample of US adults. We encourage future researchers to further explore the nuances of the educational experience as they relate to health outcomes over the lifespan, and we encourage practitioners to identify educational interventions that could have mental health benefits in subsequent decades.

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Tables

Table 1. Weighted Descriptive Statistics for Complete Case Analysis Sample (N = 4,417) by Depression Status at Age 40, National Longitudinal Survey of Youth 1979 Cohort[a], United States, 1979–2008

Weighted Proportion of Sample	Total, N = 4,417 (100%)	Not Depressed, n = 3,590 (83.8%)	Depressed, n = 827 (16.2%)	*P* Value[b]	Excluded From Analytic Sample (No. Range, 2,117–8,269)[c]
Demographic Characteristics					
Age in 1979, y, mean (SD)	17.6 (2.32)	17.6 (2.27)	17.7 (2.54)	.58	17.9 (2.33)
Female, %	51.5	49.3	63.3	< .005	47.2
Race/ethnicity, %					
Non-Hispanic white	84.9	86.1	78.9	< .005	75.9
Black/African-American	10.8	9.9	15.3		16.0
Asian	0	0	0		2.0
Hispanic/Latino	4.3	4.0	5.8		6.1
Early Life Characteristics					
Father's education, %					
Less than high school graduate	31.7	29.8	41.0	< .005	34.7
High school graduate	49.1	50.3	42.5		47.0
College graduate	19.3	19.8	16.6		18.3
Mother's education, %					
Less than high school graduate	28.5	26.4	39.4	< .005	35.0
High school graduate	60.3	62.2	50.3		56.1
College graduate	11.2	11.4	10.4		9.0
Highest education of either parent, %					
Less than high school graduate	19.1	17.4	27.7	< .005	27.5
High school graduate	58.3	59.5	52.2		66.7
College graduate	22.6	23.1	20.1		5.8
Spoke a foreign language as child, %	12.1	11.7	14.3	.06	16.1
Born outside the United States, %	3.5	3.4	4.0	.47	5.6
Lived in the South[d] as a child, %	29.7	29.1	29.3	.41	33.0
Lived in an urban (city or town) setting as a child, %	77.1	77.0	77.9	.65	78.4
Adolescent Characteristics					
Educational aspiration (mean, SD)	14.6 (2.18)	14.7 (2.13)	14.3 (2.39)	< .005	14.4 (2.31)
Educational expectation (mean, SD)	14.1 (2.25)	14.2 (2.20)	13.5 (2.40)	< .005	13.8 (2.42)
Lived in an urban area (city or town) as an adolescent, %	77.8	77.9	76.8	.56	79.4

Abbreviation: SD, standard deviation.
[a] National Longitudinal Survey of Youth 1979 Cohort (19).
[b] Calculated by *t* test or χ^2 test.
[c] Range in sample size for the percentages calculated here, from the smallest amount of missingness for a variable, 2,117, to the largest, 8,269.
[d] Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, or West Virginia.
[e] Wealth = assets – debts.

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Table 1. Weighted Descriptive Statistics for Complete Case Analysis Sample (N = 4,417) by Depression Status at Age 40, National Longitudinal Survey of Youth 1979 Cohort[a], United States, 1979–2008

Weighted Proportion of Sample	Total, N = 4,417 (100%)	Not Depressed, n = 3,590 (83.8%)	Depressed, n = 827 (16.2%)	*P* Value[b]	Excluded From Analytic Sample (No. Range, 2,117–8,269)[c]
Region of residence in 1979, %					
Northeast	20.0	20.1	19.0	.49	22.6
North Central	34.3	34.7	32.1		26.2
South	29.7	29.3	31.6		34.2
West	16.1	15.9	17.2		17.0
Adult Characteristics					
Educational attainment, %					
Did not graduate from high school by age 25	9.3	7.9	16.9	< .005	16.4
Graduated from high school by age 25	66.5	66.1	68.1		66.1
Graduated from college by age 25	24.2	26.0	15.0		17.4
Income status, mean (SD)					
Wealth[e] at age 40, $	223,721.90 (428,327.20)	223,050.60 (439,821.70)	120,332.00 (319,637.00)	< .005	145,253.40 (316,659.20)
Natural log of wealth at age 40	10.4 (3.6)	10.7 (3.2)	8.9 (4.7)	< .005	9.1 (4.4)
Annual income at age 40, $	43,849.38 (36,587.02)	45,895.20 (36,835.58)	33,289.73 (32,157.94)	< .005	32,619.15 (36,341.67)
Natural log of income at age 40	10.1 (2.0)	10.2 (1.9)	9.6 (2.6)	< .005	8.6 (3.7)
Total family annual income at age 40, $	70,776.56 (65,277.95)	74,428.33 (66,033.19)	51,927.63 (55,130.89)	< .005	57,435.72 (57,686.93)
Natural log of total family income at age 40	10.7 (1.7)	10.8 (1.5)	10.1 (2.3)	< .005	10.2 (2.2)
Family household size at age 40, mean (SD)	3.3 (1.5)	3.3 (1.5)	2.9 (1.6)	< .005	3.2 (1.6)
Number of dependents at age 40, mean (SD)	1.5 (1.3)	1.5 (1.2)	1.3 (1.3)	< .005	1.3 (1.3)
Married at age 40, %	67.4	70.1	53.4	< .005	32.0
Lived in an urban area at age 40, %	68.1	68.1	68.1	1.00	68.8
Lived in the South[d] at age 40, %	34.0	33.6	36.1	.24	40.2

Abbreviation: SD, standard deviation.
[a] National Longitudinal Survey of Youth 1979 Cohort (19).
[b] Calculated by *t* test or χ^2 test.
[c] Range in sample size for the percentages calculated here, from the smallest amount of missingness for a variable, 2,117, to the largest, 8,269.
[d] Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, or West Virginia.
[e] Wealth = assets – debts.

Table 2. Depression at Age 40 by Educational Attainment, Aspirations, and Expectations at Age 25, National Longitudinal Survey of Youth 1979 Cohort[a]

Variable	Risk Ratio (95% CI)	*P* Value
Educational attainment, unadjusted		
College graduate versus high school graduate	0.61 (0.48–0.77)	<.001
College graduate versus less than high school graduate	0.34 (0.26–0.45)	
High school graduate versus less than high school graduate	0.57 (0.47–0.68)	
Educational attainment adjusted for sex only, Wald test value for sex, *P* < .005		
College graduate versus high school graduate	0.62 (0.49–0.78)	<.001
College graduate versus less than high school graduate	0.34 (0.26–0.45)	
High school graduate versus less than high school graduate	0.56 (0.46–0.67)	
Educational attainment adjusted for child covariates[b]; Wald test value for child covariates, *P* < .005		
College graduate versus high school graduate	0.62 (0.48–0.81)	<.001
College graduate versus less than high school graduate	0.39 (0.28–0.52)	
High school graduate versus less than high school graduate	0.62 (0.51–0.75)	
Educational attainment adjusted for child and adolescent covariates[c]; Wald test value for adolescent covariates, *P* < .56		
College graduate versus high school graduate	0.62 (0.48–0.81)	<.001
College graduate versus less than high school graduate	0.39 (0.29–0.53)	
High school graduate versus less than high school graduate	0.62 (0.51–0.75)	
Educational attainment adjusted for child, adolescent, and adult covariates[d]; Wald test value for adult covariates, *P* < .005		
College graduate versus high school graduate	0.73 (0.56–0.96)	<.05
College graduate versus less than high school graduate	0.55 (0.40–0.75)	<.001
High school graduate versus less than high school graduate	0.75 (0.62–0.91)	<.01
Educational aspirations adjusted for child, adolescent, and adult covariates		
College graduate versus high school graduate	0.93 (0.79–1.10)	>.05
College graduate versus less than high school graduate	0.71 (0.42–1.19)	
High school graduate versus less than high school graduate	0.76 (0.46–1.27)	
Educational expectations adjusted for child, adolescent, and adult covariates		
College graduate versus high school graduate	0.82 (0.68–0.98)	<.05
College graduate versus less than high school graduate	0.59 (0.44–0.79)	.001
High school graduate versus less than high school graduate	0.72 (0.56–0.93)	<.05
Educational attainment adjusted for child, adolescent, and adult covariates, plus educational aspirations and educational expectations		
College graduate versus high school graduate	0.77 (0.58–1.02)	>.05
College graduate versus less than high school graduate	0.62 (0.44–0.88)	.01
High school graduate versus less than high school graduate	0.78 (0.58–1.04)	>.05

[a] National Longitudinal Survey of Youth 1979 (19). All adjusted models are adjusted for sex and race (except for sex-only models).
[b] Age in 1979, father's educational attainment, mother's educational attainment, highest educational attainment of either parent, speaking a foreign language as a child, being born outside of the United States, living in the South (Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, or West Virginia) as a child, and living in an urban setting as a child.
[c] Region of residence in the United States as an adolescent and living in an urban setting as an adolescent.
[d] Wealth (wealth = assets – debts) as an adult, income as an adult, total family income as an adult, family size as an adult, number of dependents as an adult, marital status as an adult, living in the South as an adult, and living in an urban setting as an adult.

Table 3. Depression at Age 40, by Educational Attainment, Aspirations, and Expectations at Age 25 and Race/Ethnicity in the Multiply Imputed Dataset, National Longitudinal Survey of Youth 1979 Cohort[a]

Variable	Risk Ratio (95% CI)	*P* Value
Educational attainment, unadjusted		
College graduate versus high school graduate	0.59 (0.49–0.71)	<.001
College graduate versus less than high school graduate	0.34 (0.28–0.42)	
High school graduate versus less than high school graduate	0.58 (0.51–0.66)	
Educational attainment adjusted for sex only; Wald test value for sex, *P* < .005		
College graduate versus high school graduate	0.59 (0.49–0.71)	<.001
College graduate versus less than high school graduate	0.34 (0.27–0.41)	
High school graduate versus less than high school graduate	0.57 (0.50–0.65)	
Educational attainment adjusted for child covariates[b]; Wald test value for child covariates, *P* < .005		
College graduate versus high school graduate	0.61 (0.50–0.74)	<.001
College graduate versus less than high school graduate	0.37 (0.30–0.47)	
High school graduate versus less than high school graduate	0.61 (0.54–0.70)	
Educational attainment adjusted for child[b] and adolescent covariates[c]; Wald test value for adolescent covariates, *P* < .56		
College graduate versus high school graduate	0.61 (0.50–0.75)	<.001
College graduate versus less than high school graduate	0.38 (0.30–0.47)	
High school graduate versus less than high school graduate	0.61 (0.54–0.70)	
Educational attainment adjusted for child[b], adolescent[c], and adult covariates[d]; Wald test value for adult covariates, *P* < .005		
College graduate versus high school graduate	0.70 (0.57–0.85)	<.001
College graduate versus less than high school graduate	0.51 (0.40–0.64)	
High school graduate versus less than high school graduate	0.72 (0.63–0.83)	
Educational aspirations adjusted for child[b], adolescent[c], and adult[d] covariates		
College graduate versus high school graduate	0.83 (0.74–0.94)	>.05
College graduate versus less than high school graduate	0.63 (0.45–0.90)	
High school graduate versus less than high school graduate	0.76 (0.54–1.07)	
Educational expectations adjusted for child[b], adolescent[c], and adult[d] covariates		
College graduate versus high school graduate	0.76 (0.66–0.87)	<.001
College graduate versus less than high school graduate	0.50 (0.41–0.62)	
High school graduate versus less than high school graduate	0.66 (0.56–0.79)	
Educational attainment adjusted for child[b], adolescent[c], and adult[d] covariates, plus educational aspirations and educational expectations		
College graduate versus high school graduate	0.83 (0.71–0.97)	<.05
College graduate versus less than high school graduate	0.63 (0.48–0.82)	<.01
High school graduate versus less than high school graduate	0.76 (0.62–0.95)	<.05

[a] National Longitudinal Survey of Youth 1979 (19). All adjusted models are adjusted for sex and race (except for sex-only models).
[b] Child covariates are age in 1979, father's educational attainment, mother's educational attainment, highest educational attainment of either parent, speaking a foreign language as a child, being born outside of the United States, living in the South (Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, or West Virginia) as a child, and living in an urban setting as a child.
[c] Adolescent covariates are region of residence in the United States as an adolescent and living in an urban setting as an adolescent.
[d] Adult covariates are individual and total family wealth (wealth = assets – debts), income, family size, number of dependents, marital status, living in the South as an adult, and living in an urban area as an adult, all as measured at age 40.

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ORIGINAL RESEARCH

Comorbid Depression and Obesity: Correlates and Synergistic Association With Noncommunicable Diseases Among Australian Men

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PEER REVIEWED

Summary

What is already known on this topic?

Depression and obesity are strongly related to each other.

What is added by this report?

A complex set of individual and area-level factors is associated with comorbid depression and obesity among men in Australia.

What are the implications for public health practice?

Evidence of correlates and synergistic association would be useful in designing integrated and focused health promotion interventions for Australian men.

Abstract

Introduction

Obesity and depression are among the leading causes of disease worldwide. Their bidirectional relationship often results in comorbid depression and obesity, which further increases the risk of adverse health outcomes. Further evidence is needed on the correlates and synergistic association with other noncommunicable diseases. The objective of our study was to examine the correlates and synergistic association of comorbid depression and obesity with other noncommunicable diseases in a large sample of Australian men.

Methods

Our cross-sectional study used data on 13,763 men aged 18 to 55 from the first wave (2013–2014) of the Australian Ten to Men study. Body mass index was calculated from self-reported weight and height. The Patient Health Questionnaire-9 was used to assess depression. We calculated the weighted prevalence of depression, obesity, and comorbid depression and obesity and examined correlates of comorbid depression and obesity by using logistic regression. We used the synergy index to measure the synergistic association of depression and obesity with other noncommunicable diseases.

Results

The weighted prevalence of depression, obesity, and comorbid depression and obesity among Australian men were 12.5%, 22.2%, and 3.7%, respectively. Age, marital status, area-level socioeconomic index, educational attainment, household income, employment status, and physical activity were significantly associated with comorbid depression and obesity. Men with comorbid depression and obesity, compared with men without comorbid depression and obesity, had 7.6 times the risk of diabetes and 6.7 times the risk of hypertension.

Conclusion

Co-occurrence of depression and obesity among Australian men is associated with a set of individual- and area-level correlates and a higher risk of noncommunicable diseases. The correlates identified in our study are useful in planning interventions and screening in primary care settings.

Introduction

The increasing burden of mental health disorders and obesity is a significant public health concern globally, including in Australia (1,2). An estimated 45% of Australians experience a mental health condition in their lifetime (3). In any single year, about 1 million Australians have depression and about 2 million have anxiety (4).

In 2017–2018, one in 5 Australians (20.1%) had a mental or behavioral condition; approximately two-thirds (67.0%) of Australian adults were either overweight or obese, and slightly less than one-third (31.3%) were obese (3).

Depression and obesity often co-occur. A meta-analysis of 19 studies showed a bidirectional relationship between depression and obesity (5). In that study people who were depressed had a 37% increased risk of being obese, and people who were obese had an 18% increased risk of being depressed. Only 1 study from Australia, which examined the association between body mass index (BMI) and depression among young women, was included in this meta-analysis (6). A study of the prevalence of comorbid depression and obesity in Australian general practice reported a *U*-shape relationship between BMI and depression, with a higher prevalence of depression among underweight (23%) and obese (24%) adults (7).

Noncommunicable diseases (NCDs) account for 89% of premature deaths in Australia and are major contributors to socioeconomic inequality in health (8). NCDs, especially cardiovascular disease (CVD), share many common risk factors, including modifiable lifestyle factors such as unhealthy diet, physical inactivity, harmful use of alcohol, and tobacco use. Biomedical risk factors, such as high blood pressure, diabetes, dyslipidemia, and obesity, also contribute to the development and progression of CVD. About 38% of the prevalence of CVD in Australia is attributable to overweight and obesity (9).

About 38% of the total prevalence of illness in Australia is attributable to CVD risk factors, including overweight and obesity, which account for 8.4% of the total prevalence (10). Mental health disorders, such as depression and anxiety, also have a significant association with CVD (11,12). As a result of interplay among these factors, at least 25% of Australians adults with mental health problems have chronic disease comorbidities (13).

Although the relationship between depression and obesity is considered bidirectional, the strength of the association is stronger from obesity to depression than from depression to obesity (14). In addition, sex and age moderate the relationship between depression and obesity. In a study conducted in Australia, the association was stronger among women than among men and among older people (15). The prevalence of comorbid depression was 24% among obese women and 21% among obese men. On the other hand, physical ill health is thought to mediate the relationship between obesity and depression (15).

The bidirectional relationship between depression and obesity is a public health concern because each disease alone and both diseases acting together have a strong negative effect on health and quality of life (16). Comorbid depression and obesity was shown to have a larger negative effect on quality of life than the sum of the independent effects of depression and obesity (17). The management of depression can affect obesity and vice versa. Controlled studies demonstrated that treatment of depression strongly affects body weight, although these findings are heterogeneous; the effect of treatment depends on type of antidepressant used and dose and duration of use (18).

Although the association between obesity and depression has been explored, evidence gaps still exist. First, most of the available evidence is based on studies conducted in clinical settings. As a result, limited evidence exists at community and general population levels, especially among adult men. This lack of data is important, because although the prevalence of depression is lower among men than among women in Australia, the prevalence of obesity is higher among men, and the effect of the interaction of these conditions on the risk of other NCDs has not been investigated (3).

Second, the combined effect of individual- and area-level correlates of comorbid depression and obesity have not been systematically investigated in Australia by using large population-based data sets. Third, the synergistic effects of depression and obesity on the risk of other NCDs have not been examined. Although depression and obesity are known risk factors for NCDs, we know little about their possible synergistic effect. Evidence is needed to inform prevention and treatment interventions.

Therefore, understanding the socioeconomic, behavioral, and environmental correlates of comorbid depression and obesity is essential to further understanding their complex relationship. The objective of our study was to describe individual- and area-level correlates of comorbid depression and obesity and examine their synergistic association with risk of other NCDs in a large sample of Australian men.

Methods

Data source

We used data from the first wave of the Australian Longitudinal Study on Male Health (the Ten to Men study). This ongoing longitudinal study, which uses a mailed survey, enables understanding of how changing life stages and circumstances affect the health and well-being of men and boys. Wave 1 recruitment occurred from October 2013 through July 2014; 15,988 males aged 10 to 55 years returned completed questionnaires. Our study group consisted of the 13,763 men among these who were aged 18 to 55. Wave 1 of the Ten to Men study received ethical clearance from

the University of Melbourne Human Sciences Human Ethics Sub-Committee. Participants aged 18 to 55 provided written consent. Wave 2 data were collected in 2015-2016.

A description of the cohort, methods, and sampling design in the Ten to Men study is available elsewhere (19–21). The study has a stratified, multistage, cluster sampling design and oversamples in rural and regional areas. Wave 1 included 432 Aboriginal and Torres Strait Islander people. The study questionnaire included variables on sociodemographic characteristics, geographic location, physical and emotional health, use of health care services, health behaviors, risk and protective factors, personal and family situation, life stages and life events, and social and environmental factors.

Variables and measurement

The questionnaire for the first wave of the Ten to Men study is available online (https://tentomen.org.au/sites/default/files/adult_survey_final_with_variable_names.pdf). The key variables of interest in our study were obesity and depression. We used BMI (body weight in kilograms divided by height in meters squared [kg/m^2]), calculated from self-reported body weight and standing height, to measure obesity. We classified men with a BMI of 30 kg/m^2 or more as obese. For depression, the Ten to Men study used the Patient Health Questionnaire (PHQ-9), which assesses depression on the basis of 9 symptoms (22). The questionnaire scores each of the 9 symptoms on a frequency scale from 0 (not at all) to 3 (nearly every day), and the sum of the scores determines the presence and the degree of depression. We considered a PHQ-9 score of 10 or more to indicate moderate-to-severe depression. Other variables included in our analysis were sociodemographic factors (age, marital status, educational attainment, employment status, and combined annual household income), area-level factors (using the Socio-Economic Indexes for Areas [SEIFA] [23] to measure socioeconomic advantage and disadvantage), behavioral factors (current smoking, alcohol misuse [using the Alcohol Use Disorders Identification Test (24)]), physical activity (using Australia's Physical Activity and Sedentary Behavior Guidelines for Adults [25]), number of fruit and vegetable servings per day, and the presence of NCDs other than obesity and depression: CVD (hypertension, myocardial infarction, heart failure, stroke, angina), diabetes, cancer, chronic respiratory diseases (chronic obstructive pulmonary disease, chronic bronchitis, asthma), cataracts, high cholesterol, and arthritis. The Ten to Men study assessed the presence of NCDs by using 2 questions: "Has a doctor or other health professional ever told you that you had this condition?" and "Have you been treated for or had any symptoms of this condition in the past 12 months?" We used data from the second question in our study. We measured all variables at the individual and household level, except for SEIFA and annual household income, which we measured at the area and household level, respectively.

Data analysis

We summarized the weighted prevalence of depression, obesity, and comorbid depression and obesity by sociodemographic characteristics. We used sampling weights, computed by the Ten to Men study, according to the inverse probability of selection (26). We examined correlates of depression, obesity, and comorbid depression and obesity by using multiple logistic regression models. We tabulated adjusted odds ratios (ORs) and 95% confidence intervals (CIs) for correlates of depression, obesity, and comorbid depression and obesity. To assess the effect of SEIFA (in percentiles) on the correlates of comorbid depression and obesity, we conducted stratified analysis by SEIFA quartiles (first quartile, 1–28; second quartile, 29–51, third quartile, 52–69, fourth quartile, 70–100). In this index, the higher the score, the greater the socioeconomic advantage. We used the synergy index (17) to assess the synergistic effect of depression and obesity on the risk of other NCDs. We calculated the synergy index as the ratio of the combined effects of comorbid depression and obesity to the sum of the individual effects of depression and obesity (27). We calculated 95% CIs for the synergy index by using the delta method. This method used a standard error of the synergy index that was derived from the regression coefficients and covariance of the effects of depression, obesity, and comorbid depression and obesity on each of the NCDs. We tested for multicollinearity of all covariates; the variance inflation factors were all less than 5, indicating that the assumption of reasonable independence among predictor variables was met. We analyzed all data in Stata version 15.0 (StataCorp LLC).

Results

About half (51.8%) of 13,763 men in our study were younger than 40 (Table 1). Almost two-thirds (65.3%) were married. One-quarter (24.9%) had less than a high school diploma, and 15.7% were unemployed at the time of the survey. One in 5 (19.2%) men were current smokers, 2 in 5 (38.4%) misused alcohol, and 2 in 3 (66.8%) had inadequate consumption of fruit and vegetables.

One in 8 (12.5%) men had depression. About 1 in 5 (22.2%) were obese. Nearly one-third (31.2%) of men with depression were obese, and 16.8% of men who were obese had depression. The weighted prevalence of comorbid depression and obesity was 3.7%.

Correlates of comorbid depression and obesity

The risk of depression decreased with age, whereas the risk of obesity increased with age. Higher educational attainment was associated with a lower risk of depression. Unemployment was associated with higher risk of depression. The prevalence of comorbid depression and obesity was significantly higher among men aged 30 to 39, 40 to 49, and 50 to 55 than among men aged 18 to 29. Being single or never married, being in the first SEIFA quartile, and being sedentary were significantly associated with higher risk of comorbid depression and obesity (Table 2).

The stratified analyses across SEIFA quartiles showed that age, employment status, and physical activity were consistently and significantly associated with comorbid depression and obesity across all quartiles. Married men had reduced risk of comorbid depression and obesity compared with never-married men in lower SEIFA quartiles. Higher educational attainment was significantly associated with reduced risk of comorbidity in the first and third SEIFA quartiles. Similarly, higher income was also associated with reduced risk of comorbidity in the third and fourth SEIFA quartiles (Table 3).

Synergistic association of depression and obesity with other NCDs

We found a strong positive association between comorbid depression and obesity and the risk of other NCDs. Men with comorbid depression and obesity had 7.6 times the risk of diabetes, 6.7 times the risk of hypertension, and 4.3 times the risk of high cholesterol, compared with men without comorbid depression and obesity. The analysis of synergistic effects showed a 68% excess risk of diabetes, 57% excess risk of hypertension, and more than twice the excess risk of arthritis and high cholesterol among men with comorbid depression and obesity, compared with the sum of the independent risks from depression and obesity (Table 4).

The predicted prevalence of NCDs was higher among men with comorbid depression and obesity than among men that had neither condition, men who had depression only, and men who had obesity only (Figure). The prevalence of hypertension, high cholesterol, asthma, and arthritis was higher than the prevalence of other chronic conditions included in our analysis. Stratification of these effects by SEIFA quartiles showed that the effects were higher in low SEIFA quartiles, especially for stroke, hypertension, arthritis, and high cholesterol.

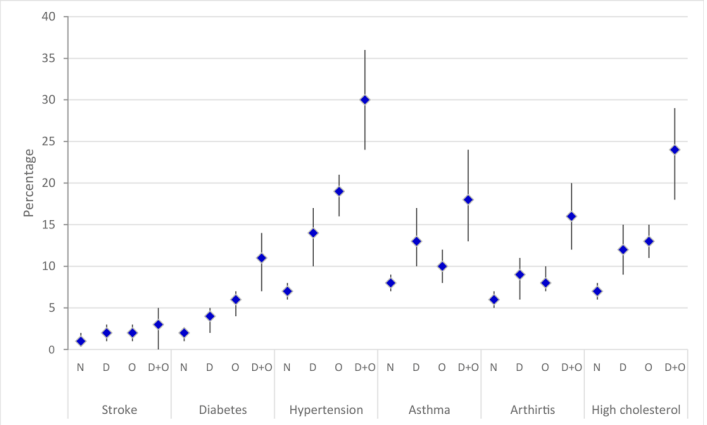

Figure. Predicted prevalence of noncommunicable diseases by neither condition (N), depression only (D), obesity only (O), and depression and obesity (D + O) among men aged 18–55 participating in wave 1 of the Ten to Men study on male health in Australia, 2013–2014. Error bars indicate 95% confidence intervals.

Discussion

We found a 3.7% overall prevalence of comorbid depression and obesity among Australian men aged 18 to 55 years. However, we observed a higher prevalence (31.2%) of obesity among men with depression than among men in the entire study population (18.5%). We also found a set of factors associated with comorbid depression and obesity. Age, employment status, and physical activity were consistently associated with comorbid depression and obesity across all levels of socioeconomic status categories. Moreover, we demonstrated a significant association between comorbid depression and obesity and excess risk of other NCDs.

A systematic review and meta-analysis of 9 studies reported that people with obesity were 32% (36% among women and 8% among men) more likely than people with normal BMI to have depression (28). Our study found a 62% increased risk of depression among men who were obese. The difference in findings between the systematic review and our study could be due to several factors. The 9 studies in the systematic review were from the United States, Canada, and Norway. They included both men and women and used different scales to assess depression. Our study was limited to Australian men and used the PHQ-9 to assess depression. One study in the systematic review used the PHQ-9 to assess depression in the National Health and Nutrition Examination Survey and estimated a 2.5 times higher risk among adults with obesity (29), higher than our estimate of risk. The difference between estimates could be due to differences in population characteristics.

The prevalence of depression among obese patients was reported to be 23% in a study of general practice clinics in Australia (7). Our study found a 17% prevalence of depression among obese men. Although the study populations differed, both studies used the PHQ-9 to assess depression, and the prevalence in the study of obese patients in general practice is not too far off the prevalence found in our study. In Mexico, a study that used the Hamilton Depression Rating Scale to assess depression in patients with type 2 diabetes reported a nearly 50% prevalence among obese patients (30). This higher prevalence could be due to the effect of type 2 diabetes on depression.

Our study found that older age and unemployment were associated with a higher risk of comorbid depression and obesity. We also showed a decline in the risk of depression but an increase in the risk of obesity as age increased. This finding is consistent with the findings reported by other studies (31,32). The higher risk of comorbid depression and obesity among unemployed men than among employed men in this study could have been due to the stronger effect of unemployment on the risk of depression among men with obesity than among men without obesity.

On the other hand, our study showed that higher educational attainment was associated with lower risk of obesity and comorbid depression and obesity. However, some studies indicated that high educational attainment was associated with greater risk of comorbid depression and obesity, with prominent effects among women (33). This difference could be related to the stronger relationship between depression and obesity among women than among men. Higher household income was negatively associated with depression and comorbid depression and obesity. Similar studies reported higher levels of mental health disorders among people with low educational attainment and low household income (34).

In our study, physical activity was associated with a lower risk of depression, obesity, and comorbid depression and obesity. This finding is consistent with findings from other studies that show the negative effects of depression on physical activity, which in turn increases the risk of obesity (35,36). However, we did not find any significant associations between smoking, alcohol use, or consumption of fruit and vegetables and comorbid depression and obesity.

In addition to the individual-level correlates, the area-level factor, SEIFA, was significantly associated with the risk of obesity and comorbid depression and obesity. Men in the lower SEIFA quartiles had a higher prevalence of depression, obesity, and comorbid depression and obesity. Similar studies in Australia reported a higher risk of obesity among socially disadvantaged people (37). The effect of SEIFA on risk of comorbid depression and obesity needs to be further explored, because other factors may explain this association.

In this study, we found a significant association between comorbid depression and obesity and excess risk of other NCDs, such as diabetes, hypertension, and high cholesterol. This association was moderated by socioeconomic status. The excess risk of other NCDs among men with comorbid depression and obesity has implications for public health: prevention, early detection, and management of NCDs are needed for men with this comorbidity. Evidence of correlates and synergistic association would be useful in designing integrated and focused health promotion interventions However, further research, preferably longitudinal research, is needed to investigate the synergistic effect of depression and obesity on the risk of other NCDs.

Our study had several limitations. First, because the study design was cross-sectional, we could not establish a sequence of events for the onset of depression, obesity, and other NCDs. Establishing this sequence would affect the direction of the association between depression and obesity. Second, the Ten to Men study was not designed to study comorbid depression and obesity or its effects on the risk of other NCDs. Consequently, the number of men with other NCDs was small, and this small number affected the power of the study, especially for determining the significance of the synergy index. Third, self-reported weight and height were used to calculate BMI, which is less accurate than height and weight measured by health care professionals. Similarly, depression was assessed by using the PHQ-9, which is based on self-report. Although this scale is well validated, the possibility of social desirability bias cannot be ruled out. Finally, this study focused on men, and the findings cannot be generalized to the overall population or women.

Our study found that the overall prevalence of comorbid depression and obesity among Australian men was 3.7%. Comorbid depression and obesity among Australian men was associated with a set of individual-level sociodemographic factors, including age, marital status, educational attainment, household income, and employment status. Among the behavioral factors studied, physical activity was significantly associated with comorbid depression and obesity. We also found an inverse association between SEIFA, an area-level factor, and comorbid depression and obesity. Comorbid depression and obesity was associated with excess risk of other NCDs. Moreover, we showed that comorbid depression and obesity was associated with a risk of NCDs that was higher than the risk found by summing the independent effects of depression and obesity. The correlates identified in our study are useful in planning interventions and screening in primary care settings. Further research is needed to explain the mechanisms that underpin these relationships.

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Tables

Table 1. Self-Reported Characteristics of Men Aged 18 to 55 Participating in Wave 1 of the Australian Longitudinal Study on Male Health (Ten to Men Study) (N = 13,763), October 2013–July 2014[a]

Characteristic/Factor	Depression Only	Obesity Only	Comorbid Depression and Obesity	Total (95% CI)
No. (% of study population)	982 (8.2)	2,461 (18.5)	510 (3.7)	—
Sociodemographic Characteristics				
Age, y				
18–29	11.0 (9.6–12.5)	11.1 (9.7–12.6)	2.5 (1.9–3.3)	25.1 (24.1–26.1)
30–39	8.3 (6.9–9.8)	16.0 (14.5–17.6)	3.8 (3.0–4.7)	26.7 (25.7–27.7)
40–49	6.4 (5.5–7.5)	23.5 (21.7–25.3)	4.1 (3.4–4.9)	30.6 (29.5–31.7)
50–55	7.8 (6.3–9.6)	23.1 (20.9–25.6)	4.7 (3.7–5.8)	17.6 (16.8–18.5)
Marital status				
Never married	12.5 (11.0–14.2)	13.2 (11.7–14.9)	4.6 (3.7–5.6)	28.0 (27.0–29.1)
Divorced/widowed/separated	14.3 (11.5–17.7)	20.7 (17.3–24.7)	7.1 (5.3–9.6)	6.6 (6.1–7.2)
Currently married	6.0 (5.3–6.7)	20.4 (19.3–21.5)	3.1 (2.6–3.5)	65.3 (64.2–66.5)
Educational attainment				
≤High school	11.5 (10.0–13.3)	20.2 (18.3–22.2)	5.9 (4.9–7.1)	24.9 (23.9–25.9)
Diploma or certificate	8.4 (7.4–9.5)	21.6 (20.2–23.1)	4.0 (3.4–4.8)	43.2 (42.0–44.4)
Bachelor's degree or above	5.5 (4.5–6.7)	12.8 (11.5–14.4)	1.8 (1.4–2.5)	30.1 (29.0–31.2)
Other	11.5 (7.0–18.2)	19.6 (11.9–30.5)	5.5 (3.0–9.7)	1.9 (1.6–2.2)
Combined annual household income, A$				
<40,000	21.1 (17.5–25.2)	17.2 (14.3–20.5)	7.9 (6.1–10.1)	11.4 (10.6–12.2)
40,000–79,999	9.1 (7.8–10.6)	18.9 (17.1–20.9)	5.4 (4.5–6.6)	26.7 (25.6–27.8)
≥80,000	5.2 (4.6–6.0)	19.2 (18.0–20.4)	2.5 (2.1–3.0)	61.9 (60.7–63.1)
Employment status				
Employed	6.4 (5.8–7.0)	18.7 (17.8–19.7)	2.8 (2.5–3.3)	84.3 (83.4–85.2)
Unemployed	19.3 (16.5–22.4)	16.9 (14.5–19.6)	9.3 (7.7–11.1)	15.7 (14.8–16.6)
Lifestyle and Behavioral Factors				
Current smoking				
No	6.5 (5.9–7.2)	18.7 (17.7–19.7)	3.3 (2.9–3.8)	80.8 (79.9–81.7)
Yes	16.0 (13.9–18.3)	17.3 (15.4–19.4)	5.6 (4.6–6.8)	19.2 (18.3–20.1)
Alcohol misuse				
No	6.9 (6.1–7.9)	19.3 (18.1–20.6)	3.3 (2.8–3.8)	61.6 (60.4–62.7)
Yes	9.6 (8.6–10.7)	18.0 (16.5–19.6)	4.2 (3.5–5.0)	38.4 (37.3–39.6)
Fruit and vegetable intake, servings per day				

[a] Values are weighted % (95% CI) unless otherwise noted.
[b] Survey participants answered the following yes–no question: "Have you been treated for or had any symptoms of this condition in the past 12 months?"
[c] The study used the Patient Health Questionnaire (PHQ-9) to assess depression on the basis of 9 symptoms (22). The questionnaire scores each of the 9 symptoms on a frequency scale from 0 (not at all) to 3 (nearly every day), and the sum of the scores determines the presence and the degree of depression. We considered a PHQ-9 score of 10 or more to indicate moderate-to-severe depression.
[d] We used BMI, calculated from self-reported body weight and standing height (body weight in kg divided by height in meters squared [kg/m^2]), to measure obesity.

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Table 1. Self-Reported Characteristics of Men Aged 18 to 55 Participating in Wave 1 of the Australian Longitudinal Study on Male Health (Ten to Men Study) (N = 13,763), October 2013–July 2014[a]

Characteristic/Factor	Depression Only	Obesity Only	Comorbid Depression and Obesity	Total (95% CI)
Adequate (≥5)	9.0 (8.2–10.0)	18.8 (17.8–20.0)	4.0 (3.6–4.6)	33.2 (32.2–34.3)
Inadequate (<5)	6.7 (5.8–7.8)	17.7 (16.2–19.3)	3.1 (2.5–3.9)	66.8 (65.7–67.8)
Physical activity, per week				
Sedentary (0 min and 0 sessions)	10.2 (8.3–12.4)	25.7 (22.9–28.7)	8.2 (6.6–10.3)	13.6 (12.8–14.4)
Insufficiently active (<150 min or <5 sessions)	9.3 (7.9–10.9)	20.0 (18.2–21.8)	4.9 (4.1–5.9)	29.1 (28.0–30.2)
Sufficiently active (>150 min in >5 sessions)	7.0 (6.3–7.9)	16.7 (15.5–18.0)	2.4 (2.0–2.9)	57.4 (56.2–58.6)
Chronic conditions[b]				
Depression (PHQ-9 ≥10)[c]	—	31.2 (28.2–34.2)	—	12.5 (11.8–13.3)
Obesity (BMI ≥30 kg/m^2)[d]	16.8 (15.2–18.6)	—	—	22.2 (21.3–23.2)
Cardiovascular disease or stroke	2.7 (1.8–4.1)	2.4 (1.7–3.4)	5.6 (3.4–9.0)	1.7 (1.4–2.1)
Diabetes	3.8 (2.7–5.2)	6.6 (5.4–8.1)	14.4 (10.9–18.7)	3.2 (2.8–3.6)
Hypertension	11.7 (9.3–14.5)	20.5 (18.4–22.7)	32.7 (27.7–38.2)	9.9 (9.3–10.6)
Asthma	14.8 (12.2–18.0)	9.6 (8.2–11.1)	20.3 (15.9–25.6)	9.1 (8.5–9.8)
Arthritis	10.9 (8.5–13.9)	9.5 (8.0–11.3)	19.4 (15.2–24.4)	6.9 (6.4–7.6)
High cholesterol	9.4 (7.6–11.6)	13.8 (12.0–15.8)	26.1 (21.3–31.5)	8.8 (8.1–9.5)

[a] Values are weighted % (95% CI) unless otherwise noted.
[b] Survey participants answered the following yes–no question: "Have you been treated for or had any symptoms of this condition in the past 12 months?"
[c] The study used the Patient Health Questionnaire (PHQ-9) to assess depression on the basis of 9 symptoms (22). The questionnaire scores each of the 9 symptoms on a frequency scale from 0 (not at all) to 3 (nearly every day), and the sum of the scores determines the presence and the degree of depression. We considered a PHQ-9 score of 10 or more to indicate moderate-to-severe depression.
[d] We used BMI, calculated from self-reported body weight and standing height (body weight in kg divided by height in meters squared [kg/m^2]), to measure obesity.

Table 2. Prevalence and Correlates of Depression, Obesity, and Comorbid Depression and Obesity Among Men Aged 18 to 55 Participating in Wave 1 of the Australian Longitudinal Study on Male Health (Ten to Men Study) (N = 13,763), October 2013–July 2014[a]

Characteristic/Factor	Depression Only	Obesity Only	Comorbid Depression and Obesity
Sociodemographic Characteristics			
Age, y			
18–29	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
30–39	0.86 (0.64–1.16) [.32]	1.47 (1.14–1.91) [.004]	4.46 (2.60–7.66) [<.001]
40–49	0.68 (0.50–0.91) [.01]	2.34 (1.82–3.01) [<.001]	4.58 (2.59–8.09) [<.001]
50–55	0.61 (0.43–0.86) [.005]	2.22 (1.7–2.91) [<.001]	4.53 (2.50–8.21) [<.001]
Marital status			
Never married	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Divorced/widowed/separated	1.36 (0.93–1.98) [.11]	0.90 (0.63–1.30) [.59]	0.71 (0.40–1.25) [.23]
Currently married	0.78 (0.60–1.02) [.07]	1.04 (0.82–1.31) [.78]	0.48 (0.31–0.75) [.001]
Educational attainment			
≤High school	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Diploma or certificate	0.92 (0.72–1.16) [.48]	0.91 (0.76–1.10) [.35]	0.72 (0.51–1.01) [.06]
Bachelor's degree or above	0.75 (0.55–1.05) [.09]	0.60 (0.48–0.75) [<.001]	0.42 (0.27–0.67) [<.001]
Other	1.18 (0.71–1.98) [.52]	0.96 (0.42–2.18) [.92]	1.06 (0.46–2.45) [.89]
Combined annual household income, A$			
<40,000	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
40,000–79,999	0.69 (0.50–0.94) [.02]	1.15 (0.82–1.61) [.42]	0.82 (0.49–1.38) [.46]
≥80,000	0.48 (0.34–0.66) [<.001]	1.22 (0.88–1.68) [.24]	0.54 (0.32–0.93) [.03]
Employment status			
Employed	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Unemployed	2.87 (2.17–3.78) [<.001]	1.09 (0.82–1.45) [.56]	3.33 (2.25–4.93) [<.001]
SEIFA quartiles[b]			
First	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Second	1.03 (0.78–1.35) [.85]	0.81 (0.66–1.00) [.048]	0.95 (0.64–1.40) [.80]
Third	0.84 (0.62–1.12) [.23]	0.75 (0.61–0.93) [.007]	0.85 (0.58–1.27) [.43]
Fourth	0.96 (0.72–1.27) [.76]	0.54 (0.44–0.68) [<.001]	0.36 (0.23–0.56) [<.001]
Lifestyle and Behavioral Factors			
Current smoking			
No	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Yes	1.68 (1.33–2.12) [<.001]	0.85 (0.69–1.04) [.12]	0.81 (0.55–1.17) [.26]
Alcohol misuse			
No	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Yes	1.43 (1.16–1.76) [.001]	0.94 (0.80–1.10) [.44]	1.26 (0.92–1.73) [.15]

[a] All values are odds ratio (95% confidence interval) [*P* value]. All odds ratios were adjusted for other characteristics included in this table. Except for SEIFA quartiles, all data were self-reported.

[b] We used the Socio-Economic Indexes for Areas (SEIFA) to measure socioeconomic status (23). Data were stratified by SEIFA quartiles (first quartile, 1–28; second quartile, 29–51, third quartile, 52–69, fourth quartile, 70–100). In this index, the higher the score (and quartile), the greater the socioeconomic advantage.

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Table 2. Prevalence and Correlates of Depression, Obesity, and Comorbid Depression and Obesity Among Men Aged 18 to 55 Participating in Wave 1 of the Australian Longitudinal Study on Male Health (Ten to Men Study) (N = 13,763), October 2013–July 2014[a]

Characteristic/Factor	Depression Only	Obesity Only	Comorbid Depression and Obesity
Fruit and vegetable intake, servings per day			
Adequate (≥5)	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Inadequate (<5)	1.13 (0.90–1.42) [.30]	1.04 (0.89–1.22) [.59]	1.10 (0.79–1.53) [.57]
Physical activity, per week			
Sedentary (0 min and 0 sessions)	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Insufficiently active (<150 min or <5 sessions)	0.87 (0.65–1.16) [.34]	0.78 (0.62–0.98) [.04]	0.59 (0.40–0.87) [.008]
Sufficiently active (>150 min in >5 sessions)	0.63 (0.47–0.84) [.001]	0.68 (0.55–0.84) [<.001]	0.27 (0.17–0.41) [<.001]

[a] All values are odds ratio (95% confidence interval) [*P* value]. All odds ratios were adjusted for other characteristics included in this table. Except for SEIFA quartiles, all data were self-reported.
[b] We used the Socio-Economic Indexes for Areas (SEIFA) to measure socioeconomic status (23). Data were stratified by SEIFA quartiles (first quartile, 1–28; second quartile, 29–51, third quartile, 52–69, fourth quartile, 70–100). In this index, the higher the score (and quartile), the greater the socioeconomic advantage.

Table 3. Correlates of Comorbid Depression and Obesity, by SEIFA Quartiles,[a] Among Men Aged 18 to 55 Participating in Wave 1 of the Australian Longitudinal Study on Male Health (Ten to Men Study) (N = 13,763), October 2013–July 2014[b]

Characteristic/Factor	1st Quartile	2nd Quartile	3rd Quartile	4th Quartile
Age, y				
18–29	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
30–39	4.32 (1.84–10.16) [.001]	3.54 (1.12–11.21) [.03]	5.30 (1.62–17.32) [.006]	5.69 (1.20–27.02) [.03]
40–49	2.61 (1.06–6.40) [.04]	6.36 (1.98–20.39) [.002]	5.69 (1.57–20.60) [.008]	7.69 (1.58–37.29) [.01]
50–55	4.33 (1.74–10.76) [.002]	5.67 (1.73–18.59) [.004]	3.56 (0.94–13.50) [.06]	5.28 (0.98–28.56) [.05]
Marital status				
Never married	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Previously married	0.67 (0.30–1.52) [.34]	0.51 (0.16–1.61) [.25]	0.89 (0.26–3.06) [.86]	1.81 (0.39–8.36) [.44]
Currently married	0.51 (0.27–0.97 [.04]	0.40 (0.17–0.96) [.04]	0.51 (0.18–1.46) [.21]	0.42 (0.13–1.31) [.13]
Educational attainment				
≤High school	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Diploma or certificate	0.75 (0.42–1.33) [.32]	0.97 (0.53–1.80) [.93]	0.61 (0.31–1.19) [.15]	0.45 (0.15–1.30) [.14]
Bachelor's degree or above	0.32 (0.12–0.84) [.02]	0.73 (0.33–1.61) [.43]	0.31 (0.13–0.77) [.01]	0.41(0.14–1.16) [.09]
Other	0.77 (0.13–4.48) [.77]	1.05 (0.25–4.49) [.94]	4.08 (1.01–16.41) [.048]	—[c]
Combined annual household income, A$				
<40,000	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
40,000–79,999	1.04 (0.48–2.23) [.92]	1.25 (0.49–3.15) [.64]	0.51 (0.17–1.54) [.23]	0.20 (0.05–0.91) [.04]
≥80,000	0.55 (0.23–1.30) [.17]	0.80 (0.32–1.97) [.62]	0.32 (0.10–1.01) [.05]	0.59 (0.18–1.95) [.39]
Employment status				
Employed	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Unemployed	3.06 (1.64–5.71) [<.001]	3.70 (1.76–7.78) [.001]	3.42 (1.47–7.92) [.004]	4.71 (1.68–13.21) [.003]
Current smoking				
No	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Yes	0.89 (0.53–1.50) [.66]	0.70 (0.36–1.38) [.30]	1.06 (0.43–2.60) [.90]	0.58 (0.20–1.69) [.32]
Alcohol misuse				
No	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Yes	1.05 (0.61–1.81) [.86]	1.07 (0.56–2.05) [.84]	1.58 (0.80–3.09) [.18]	1.73 (0.82–3.63) [.15]
Fruit and vegetable intake, servings per day				
≥5	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
<5	0.79 (0.45–1.40) [.43]	1.20 (0.60–2.41) [.60]	1.67 (0.87–3.17) [.12]	1.47 (0.68–3.16) [.32]
Physical activity				
Sedentary (0 min and 0 sessions)	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Insufficiently active (<150 min or <5 sessions)	0.62 (0.32–1.23) [.17]	0.36 (0.18–0.73) [.004]	0.58 (0.28–1.20) [.14]	0.84 (0.30–2.35) [.74]
Sufficiently active (>150 min in >5 sessions)	0.26 (0.12–0.56) [.001]	0.28 (0.14–0.60) [.001]	0.27 (0.12–0.58) [.001]	0.17 (0.05–0.55) [.003]

[a] We used the Socio-Economic Indexes for Areas (SEIFA) to measure socioeconomic status (23). Data were stratified by SEIFA quartiles (first quartile, 1–28; second quartile, 29–51, third quartile, 52–69, fourth quartile, 70–100). In this index, the higher the score (and quartile), the greater the socioeconomic advantage.
[b] All values are odds ratio (95% confidence interval) [*P* value].
[c] Numbers too small to make calculation.

Table 4. Association Between Comorbid Depression and Obesity and Other Noncommunicable Diseases Among Men Aged 18 to 55 Participating in Wave 1 of the Australian Longitudinal Study on Male Health (Ten to Men Study) (N = 13,763), October 2013–July 2014[a]

Noncommunicable Disease	Odds Ratio (95% Confidence Interval) [*P* Value]	Synergy Index (95% Confidence Interval)[b]
Cardiovascular disease/stroke		
Depressive symptoms only	1.54 (0.75–3.16) [.24]	—
Obesity only	1.25 (0.71–2.20) [.45]	—
Depressive symptoms and obesity	1.86 (0.70–5.00) [.22]	1.10 (0.11–11.31)
Diabetes		
Depressive symptoms only	2.26 (1.19–4.28) [.01]	—
Obesity only	3.67 (2.44–5.53) [<.001]	—
Depressive symptoms and obesity	7.62 (4.51–12.87) [<.001]	1.68 (0.92–3.08)
Hypertension		
Depressive symptoms only	2.29 (1.61–3.26) [<.001]	—
Obesity only	3.36 (2.69–4.19) [<.001]	—
Depressive symptoms and obesity	6.74 (4.73–9.60) [<.001]	1.57 (1.02–2.44)
Asthma		
Depressive symptoms only	1.81 (1.29–2.52) [.001]	—
Obesity only	1.36 (1.08–1.72) [.01]	—
Depressive symptoms and obesity	2.69 (1.81–4.00) [<.001]	1.45 (0.66–3.19)
Arthritis		
Depressive symptoms only	1.42 (0.94–2.13) [.09]	—
Obesity only	1.35 (1.03–1.77) [.03]	—
Depressive symptoms and obesity	3.02 (2.07–4.40) [<.001]	2.62 (0.98–7.01)
High cholesterol		
Depressive symptoms only	1.72 (1.18–2.51) [.004]	—
Obesity only	1.90 (1.48–2.43) [<.001]	—
Depressive symptoms and obesity	4.31 (2.93–6.34) [<.001]	2.04 (1.11–3.75)

[a] Outcome variables were each of the noncommunicable diseases. Main predictor was combination of depression and obesity. All models were adjusted for the Socio-Economic Indexes for Areas (23), age, income, marital status, educational attainment, smoking, alcohol, physical activity, and employment.
[b] The synergy index shows the excess risk from comorbid depression and obesity when compared with the sum of independent risks from depression and obesity. For example, a synergy index of 2 means the risk of high cholesterol among men with comorbid depression and obesity is 2 times the sum of independent risks from depression and obesity.

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Trouble Sleeping and Depression Among US Women Aged 20 to 30 Years

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PEER REVIEWED

Summary

What is already known on this topic?

Sleep problems are associated with depression; however, little is known about this association among young women in the United States.

What is added by this report?

Women aged 20 to 30 who reported having trouble sleeping were 4.1 times significantly more likely to have experienced depression in the previous 2 weeks after accounting for several covariates.

What are the implications for public health practice?

Regular screening and treatment of sleep disturbances are needed among US women aged 20 to 30 to reduce the prevalence of depression among this population.

Abstract

Introduction

Depression in women is common, and 1 woman in 4 is likely to have an episode of major depression at some point in her life. Sleep disturbances, which are significantly associated with depression, are increasingly recognized as a determinant of women's health and well-being. Although studies have examined the association between depression and sleep disorders, little research has explored this association among young women. Our study investigated the relationship between sleep problems and depression among women aged 20 to 30.

Methods

We used data on 1,747 women from the US National Health and Nutrition Examination Survey (NHANES) 2009–2016. In addition to univariate and bivariate analysis, we used unadjusted and adjusted logistic regression models to estimate depression in the previous 2 weeks among women who reported ever having trouble sleeping.

Results

Of 1,747 study participants, 19.6% reported trouble sleeping and 9.3% reported symptoms of depression. Weighted logistic regression results showed that women who had trouble sleeping were more than 4 times (odds ratio, 4.36; 95% confidence interval, 3.06–6.21; $P < .001$) more likely than women who did not have trouble sleeping to have had depression in the previous 2 weeks. The results were similar (adjusted odds ratio, 4.11; 95% confidence interval, 2.78–6.06; $P < .001$) after adjusting for other covariates.

Conclusion

We found a significant relationship between trouble sleeping and depression among US women aged 20 to 30. Findings suggest the need for regular screening and treatment of sleep disturbances among young women, which may improve their psychological health and reduce depression.

Introduction

Depression is one of the most common psychiatric disorders. In the United States, depressive disorders were the second leading cause of years lived with disability in 2010 (1). Women are more likely to have depression than men. During 2013–2016, 10.4% of US women aged 20 or older had depression in a given 2-week period and were almost twice as likely as men (5.5%) to have had depression (2). Although this sex difference persists throughout the female lifespan, it seems to vary according to reproductive stage (puberty, the week or so before menstruation, after pregnancy, and perimenopause) (3). Female hormonal fluctuation may be a trigger for depression (3). Depression is associated with decreased physical, cognitive, and social function; it is often chronic and impairs quality of life (4). Depression is predicted to be the leading cause of disease burden by 2030, and it is already the leading cause of disease burden in young adult women worldwide (3).

Therefore, treatment and prevention of depression have become an important topic in the field of public health.

Sleep is an important determinant of a person's overall health and well-being. Sleep, as a critical health-related factor, plays a role in the development of many diseases and even all-cause mortality (5). Sleep disturbance is one of the most common health complaints among young adults (6,7). Although 7 to 9 hours of sleep per night on weeknights is recommended for young and midlife adults (8), 40% of US adults have reported fewer than 7 hours of sleep per night (9). Of young adults aged 19 to 29, 67% reported not getting enough sleep to function properly (10). Many psychosocial, biological, and environmental factors contribute to insufficient sleep and sleep disturbance among young adults. The high prevalence of sleep-related disturbances may be partially due to increased academic, social, and work demands (11). Female sex is also a risk factor for sleep problems. Several studies showed that young adult women are twice as likely as young men to have poor sleep (12,13). Thus, young women appear to be a particularly vulnerable population to both sleep problems and depression.

Previous studies suggested an association between depression and sleep disturbances in older people (14,15) and an association between sleep disturbances and poor quality of life among women (16). Less research has been conducted among young adults, who are at particular risk of sleep problems and alterations in circadian timing as a result of developmental and social influences. This age group is at an important stage of life, when early interventions or treatment of sleep problems may have clinical implications. Little research has explored the relationship between sleep and depression among young women, even though the correlates of depression may differ between young women and older women. Understanding the relationships between sleep and depression and correlates among young women may increase the potential to intervene and improve mental health outcomes before they become clinically concerning. The objective of our study was to assess the relationship between trouble sleeping and depression among US women aged 20 to 30 and to determine whether trouble sleeping increased the odds of depression in this population. We hypothesized that ever having trouble sleeping would be associated with depression among women in this age group.

Methods

We used data from the US National Health and Nutrition Examination Survey (NHANES) for 2009–2016. NHANES is a cross-sectional survey representing the noninstitutionalized civilian resident population of the United States (17). Each year, about 5,000 people are interviewed in their homes and complete the health examination components of the survey, which include medical, dental, and physiological measurements and laboratory test evaluations, usually administered in specially designed and equipped mobile examination centers located throughout the country. Interview teams consist of physicians, medical and health technicians, and trained dietary and health interviewers. The survey excludes all persons living on military bases and in institutional settings and all US citizens residing outside the 50 states and District of Columbia (17). Our analytic sample consisted of 1,747 women aged 20 to 30 who participated in NHANES at 4 sampling time points (2009–2010, 2011–2012, 2013–2014, and 2015–2016). We excluded pregnant women because pregnancy can be psychologically stressful and affect normal sleep. NHANES received approval from the National Center for Health Statistics Research Ethics Review Board, and all participants provided informed consent. Because NHANES is a public-use data set, this study was exempt from full institutional review board review. A detailed description of the data and the analytical guidelines are available elsewhere (17).

Assessments

The sleep disorders questionnaire was administered in the home by computer-assisted personal interview during the initial survey participant interview. Participants were asked the following question about trouble sleeping: "Have you ever told a doctor or other health professional that you have trouble sleeping?" If the participant's response to this question was yes, she was considered to have trouble sleeping.

Depressive symptoms were assessed via the Patient Health Questionnaire-9 (PHQ-9), a self-administered questionnaire that assesses depressive symptoms according to the guidelines of the fourth edition of the Diagnostic and Statistical Manual for Mental Disorders (DSM-IV) (18). Each question is scored according to the frequency of the symptom during the previous 2 weeks, and responses are made on the following scale: not at all (0), several days (1), more than half the days (2), and nearly every day (3). The PHQ-9 is considered an effective tool for assessing depressive symptoms and a reliable tool for determining instances of both subthreshold and major depression among population samples (19). A total PHQ-9 score greater than 9 (of a possible 27) indicates the presence of depression in single-screening assessments (20), and we used this cutoff. Depression was treated as the dependent variable in our analysis.

Descriptive variables

Descriptive variables were age group (20–25 and 26–30), race/ethnicity (Hispanic, non-Hispanic white, non-Hispanic black, and other), education level (<high school graduate, high school graduate, some college, and college graduate or above), marital status

(married/living together, widowed/divorced/separated, and never married), family size (1 or 2, 3 or 4, ≥5), poverty level (below 100% federal poverty level [FPL], 100%–199% FPL, 200%–299% FPL, and ≥300% FPL), health insurance (yes, has insurance vs no, does not have insurance), diabetes (yes, has diabetes vs no, does not have diabetes), and ever use of marijuana (yes vs no). The information was collected via home interview at the time of the assessments.

Statistical analysis

NHANES uses a stratified, multistage complex survey design to enhance the representativeness of the US population. We followed the analytical guidelines suggested by NHANES. Weighting was applied to account for the sampling strata and the primary sampling unit and to adjust for oversampling and survey nonresponse. Because of the complex survey design of NHANES, we used the *svy* command in Stata version 14 (StataCorp LLP) to obtain correct variance estimation. We conducted descriptive analysis (means and proportions) of our study population. We used χ^2 analysis to conduct bivariate analysis between all independent variables and the dependent variable (depression). Because depression is a dichotomous variable, we estimated several unadjusted and adjusted logistic regression models. We tabulated results of logistic regression models as odds ratios (ORs) and 95% confidence intervals (CIs) for all independent variables for both unadjusted and adjusted models. All percentages were reported as weighted percentages. Significance level was set at $P \leq .05$.

Results

Approximately 9.3% of our sample of 1,747 women reported having depression in the previous 2 weeks (Table 1). The prevalence of having trouble sleeping was 19.6%. Among women who reported trouble sleeping, 22.3% reported having depression in the previous 2 weeks. Most (55.9%) of the women in our sample were aged 20 to 25. Most were non-Hispanic white (59.4%), followed by Hispanic (17.7%), non-Hispanic black (13.5%), and other races (9.4%). About two-fifths (41.9%) had some college. Most women (48.1%) were married or living together, and about 25.4% were living below 100% of the FPL. Most respondents had health insurance coverage (75.6%). More than half (57.9%) reported ever using marijuana, and marijuana use was more common among women who reported having a sleep problem (70.3%).

Depression was significantly more prevalent among women who reported ever having trouble sleeping (22.6%) than among women reporting no trouble (6.5%) and significantly more prevalent among women aged 20 to 25 (10.7%) than among women aged 26 to 30 (8.1%) (Table 2). The prevalence of depression was higher among women who did not complete high school (12.9%) than among women with a high school degree (11.3%), some college (10.7%), or a college degree or above (4.1%). Similarly, the prevalence of depression was also significantly higher among women living below 100% of the FPL (12.9%) than among women in other categories of income, among women without health insurance than among women with health insurance (12.8% vs 8.3%), among women with diabetes than among women without diabetes (24.0% vs 9.3%), and among women who ever used marijuana than among women who never used it (12.9% vs 5.4%).

Trouble sleeping was significantly associated with depression among women aged 20 to 30 (Table 3). In the unadjusted model, women who reported trouble sleeping were more than 4 times more likely than women who did not report trouble sleeping to have had depression in the previous 2 weeks (OR, 4.36; 95% CI, 3.06–6.21; $P < .001$). The odds of depression remained high and significant (AOR, 4.11; 95% CI, 2.78–6.06; $P < .001$) among women who reported having trouble sleeping after controlling for the effect of the covariates in the model. Age was not significantly associated with depression. Education had an inverse relationship with depression: the higher the level of education, the lower the odds of depression.

In the adjusted model, compared with women who had at least a college degree, women with some college were about 2 times more likely (AOR, 1.88; 95% CI, 1.01–3.45; $P = .046$) to have depression in the previous 2 weeks. Women who were widowed, divorced, or separated (AOR, 2.46; 95% CI, 1.08–5.62; $P = .03$) or never married (AOR, 1.74, 95% CI, 1.03–2.94; $P = .04$) were more likely to have depression than women who were married or living together. Family size was not significantly associated with depression; however, FPL was. Women living below 100% of the FPL were 86% more likely to have depression (AOR, 1.86; 95% CI, 1.02–3.38; $P = .04$) than women living at or above 300% FPL. Additionally, women with health insurance were 35% (AOR, 0.65; 95% CI, 0.42–0.98; $P = .04$) less likely to have depression than women who did not have health insurance. Having diabetes increased the odds of having depression (AOR, 3.99; 95% CI, 1.06–15.13; $P = .04$). Furthermore, ever marijuana use among women was significantly associated with depression. Women who ever used marijuana were 1.84 times (AOR, 1.84; 95% CI, 1.09–3.12; $P = .02$) more likely to have depression than women who did not use marijuana.

Discussion

Our study demonstrated a strong and significant association between trouble sleeping and depression in a nationally representative sample of US women aged 20 to 30. Young women who reported trouble sleeping were significantly more likely to have de-

pression than those who had no sleep problems. After adjusting for several socioeconomic, demographic, and health-related factors (ie, race/ethnicity, age, education, marital status, family size, poverty status, health insurance status, diabetes, and marijuana use), the association remained significant.

Although previous research is scant in similar populations, our findings on sleep problems among young women are consistent with those in a previous study of young women in Australia, which showed an increased risk of depression among women who reported sleep difficulties (21). Another important finding of our study is that women with lower educational attainment were more likely to report depression than those with more education; for example, women with only some college were significantly more likely than women with a college degree or more to report depression. An association between lower educational attainment and higher risk for depressive disorders was shown in previous studies. A meta-analysis found a 3% decrease in the log odds ratio for depression for each additional year of education (22). Several studies also documented the relationship between educational attainment and sleep problems: higher levels of education were associated with fewer sleep complaints (23,24). Our finding on the relationship between education and depression may be important because it strengthens evidence for the idea that obtaining higher levels of education may protect against depression among young women. Considering the possible protective role of education against depression, we further analyzed the interaction between education and sleep. However, the interaction model was not significant; hence, we did not present these findings here.

We also found a higher prevalence of depression among women living below the FPL. This finding is also congruent with previous research findings. One study reported a higher prevalence of depression in people of low socioeconomic status (25). In that study, women had a 40% greater risk of past-month depression than men, and women with income levels below the FPL had twice the risk of depression of men (25). Therefore, interventions aimed at reducing the burden of depression may need to target vulnerable populations of young women who have limited financial resources.

We found that depression was significantly associated with health insurance status and was less common among women with health insurance than among those without. This finding may be particularly important because previous research showed that uninsured people with depression and other mental illnesses were less likely than insured people to receive appropriate care (26). Furthermore, our study found that women with diabetes were significantly more likely to have depression. The prevalence of depression is higher among people with diabetes than among the general population (27). Therefore, health care providers should be aware of mental as well as physical health when treating patients with diabetes. This finding implies that health care professionals may have an important role in moderating the psychological burden of a diabetes diagnosis by addressing the patient's psychosocial support.

Comorbidity of depression and marijuana use has been studied extensively, with evidence showing a high prevalence of depression among marijuana users (28). Our study found a higher prevalence of depression among young women who ever used marijuana than among women who had never used it, which is consistent with previous research (28). However, we could not differentiate between recreational and medical marijuana use. Given the changing political landscape of marijuana use, further studies focused on the potential effects and differences between recreational and medical marijuana use on depression among young women will be needed to shape prevention and treatment strategies.

Although our χ^2 test found that women aged 20 to 25 were significantly more likely than women aged 26 to 30 to report depression, this relationship between age and depression was not significant after we adjusted for other covariates. That this relationship became nonsignificant may have been due to the small sample size or the effects of other factors contributing to the relationship. However, one previous study documented that the prevalence of major depression decreased with age (29). Therefore, younger age may be significantly associated with depression, and future research should further investigate the relationship between age and depression.

Our study has several strengths. Our research included a large, population-based, representative sample of young women in the assessment of the association between sleep disturbances and depression, allowing broad generalization of the results. Additionally, the NHANES data set provides information on a large sample of the general population, rather than on a specific patient group, and thereby provides information on the degree of disease burden at this level. Moreover, we made statistical adjustments for differences in a number of health and lifestyle covariates. Such an approach provided a more detailed assessment of the strength of the association.

Our study has several limitations. Although some people may have sleep disturbances before developing depressive symptoms, some may have a depression disorder before the onset of sleep disturbances. The cross-sectional design of our analysis did not allow for interpretation of the direction of the relationship, and a causal relationship cannot be inferred. Moreover, the cross-sectional design and use of secondary data limited the scope of the variable of interest. Additionally, our study estimated the prevalence of trouble sleeping among young women who ever reported having sleep disturbances to a doctor or a health professional.

Therefore, we could not differentiate between women with recent sleep disturbances and women with former sleep disturbances. Another limitation of the study was that most of the information collected was self-reported. However, despite these limitations, we believe this nationally representative sample provides some insight into associations between sleep disturbance and depression among young women in the United States.

Women aged 20 to 30 with sleep disturbances should have access to screening and treatment from health professionals, and appropriate interventions should be directed to reduce depression in this vulnerable population. The association between trouble sleeping and depression has public health implications: young women seeking treatment for sleep problems may need to be screened for depression. Interventions that are designed to help such women may result in a decreased prevalence of depression in this population. Sleep is essential, and healthy sleep should be as important as healthy nutrition and physical activity in promoting overall health.

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Tables

Table 1. Descriptive Statistics of the Study Sample (N = 1,747), Women Aged 20–30, National Health and Nutrition Examination Survey (NHANES), 2009–2016[a]

Variable	Trouble Sleeping		Total, n (%)
	No, n (%)	Yes, n (%)	
Total	1,420 (80.4)	327 (19.6)	1,747 (100.0)
Depression in previous 2 weeks			
No	1,327 (93.8)	253 (77.7)	1,580 (90.7)
Yes	93 (6.2)	74 (22.3)	167 (9.3)
Age, y[b]			
20–25	809 (57.3)	164 (50.1)	973 (55.9)
26–30	611 (42.7)	163 (49.9)	774 (44.1)
Race/ethnicity			
Hispanic	381 (18.7)	66 (13.4)	447 (17.7)
Non-Hispanic white	510 (57.2)	160 (68.3)	670 (59.4)
Non-Hispanic black	317 (14.3)	59 (10.5)	376 (13.5)
Other	212 (9.8)	42 (7.7)	254 (9.4)
Education			
<High school graduate	195 (10.6)	46 (12.2)	241 (11.0)
High school graduate	286 (18.9)	67 (21.7)	353 (19.4)
Some college	590 (41.5)	148 (43.3)	738 (41.9)
≥College graduate	349 (28.9)	66 (22.8)	415 (27.7)
Marital status			
Married/living together	643 (47.9)	148 (48.9)	791 (48.1)
Widowed/divorced/separated	51 (3.7)	23 (6.2)	74 (4.2)
Never married	726 (48.4)	156 (44.9)	882 (47.7)
Family size[c]			
1 or 2	535 (43.6)	123 (39.7)	658 (42.8)
3 or 4	522 (37.3)	131 (42.3)	653 (38.3)
≥5	363 (19.1)	73 (18.0)	436 (18.9)
Percentage of federal poverty level			
<100	445 (24.5)	115 (29.1)	560 (25.4)
100–199	373 (22.9)	79 (25.1)	452 (23.3)
200–299	212 (17.4)	39 (13.1)	251 (16.6)
≥300	390 (35.3)	94 (32.7)	484 (34.7)
Has health insurance			
No	427 (25.6)	66 (19.5)	493 (24.4)

Abbreviation: SD, standard deviation.
[a] Percentages and means were weighted and incorporated NHANES sample weights.
[b] Mean (SD) age was 24.9 (3.2) years.
[c] Mean (SD) family size was 3.3 (1.8).

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Table 1. Descriptive Statistics of the Study Sample (N = 1,747), Women Aged 20–30, National Health and Nutrition Examination Survey (NHANES), 2009–2016[a]

Variable	Trouble Sleeping		Total, n (%)
	No, n (%)	Yes, n (%)	
Yes	993 (74.4)	261 (80.5)	1,254 (75.6)
Has diabetes			
No	1,402 (99.0)	320 (97.9)	1,722 (98.8)
Yes	18 (1.0)	7 (2.1)	25 (1.2)
Ever used marijuana			
No	682 (45.1)	107 (29.7)	789 (42.1)
Yes	738 (54.9)	220 (70.3)	958 (57.9)

Abbreviation: SD, standard deviation.
[a] Percentages and means were weighted and incorporated NHANES sample weights.
[b] Mean (SD) age was 24.9 (3.2) years.
[c] Mean (SD) family size was 3.3 (1.8).

Table 2. Bivariate Relationship Between Ever Having Trouble Sleeping and Depression in Previous 2 Weeks Among Women Aged 20–30, National Health and Nutrition Examination Survey, 2009–2016

Variable	Depression in Previous 2 Weeks		χ^2 Test (*P* Value[b])
	No, n (%)[a]	Yes, n (%)	
Total	1,580 (90.7)	167 (9.3)	NA
Ever have trouble sleeping			
No	1,327 (93.5)	93 (6.5)	166.7 (<.001)
Yes	253 (77.4)	74 (22.6)	
Age, y			
20–25	869 (89.3)	104 (10.7)	13.9 (.01)
26–30	711 (91.9)	63 (8.1)	
Race/ethnicity			
Hispanic	412 (92.2)	35 (7.8)	13.6 (.06)
Non-Hispanic white	597 (89.1)	73 (10.9)	
Non-Hispanic black	329 (87.5)	47 (12.5)	
Other	242 (95.3)	12 (4.7)	
Education			
<High school graduate	210 (87.1)	31 (12.9)	56.3 (<.001)
High school graduate	313 (88.7)	40 (11.3)	
Some college	659 (89.3)	79 (10.7)	
≥College graduate	398 (95.9)	17 (4.1)	
Marital status			
Married/living together	733 (92.7)	58 (7.3)	31.6 (.005)
Widowed/divorced/separated	60 (81.1)	14 (18.9)	
Never married	787 (89.2)	95 (10.8)	
Family size			
1 or 2	600 (91.2)	58 (8.8)	7.9 (.20)
3 or 4	582 (89.1)	71 (10.9)	
≥5	398 (91.3)	38 (8.7)	
Percentage of federal poverty level			
<100	488 (87.1)	72 (12.9)	51.3 (<.001)
100–199	401 (88.7)	51 (11.3)	
200–299	233 (92.8)	18 (7.2)	
≥300	458 (94.6)	26 (5.4)	
Has health insurance			
No	430 (87.2)	63 (12.8)	21.2 (.001)
Yes	1,150 (91.7)	104 (8.3)	
Has diabetes			

Abbreviation: NA, not applicable.
[a] Percentages are row percentages.
[b] *P* values were determined by χ^2 test on the weighted data.

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Table 2. Bivariate Relationship Between Ever Having Trouble Sleeping and Depression in Previous 2 Weeks Among Women Aged 20–30, National Health and Nutrition Examination Survey, 2009–2016

Variable	Depression in Previous 2 Weeks		χ^2 Test (*P* Value[b])
	No, n (%)[a]	Yes, n (%)	
No	1,561 (90.7)	161 (9.3)	34.3 (.001)
Yes	19 (76.0)	6 (24.0)	
Ever used marijuana			
No	746 (94.6)	43 (5.4)	44.1 (<.001)
Yes	834 (87.1)	124 (12.9)	

Abbreviation: NA, not applicable.
[a] Percentages are row percentages.
[b] *P* values were determined by χ^2 test on the weighted data.

Table 3. Odds Ratios and Confidence Intervals for the Logistic Regression Estimate for the Relationship Between Ever Trouble Sleeping and Depression in Past 2 Weeks Among Women Aged 20–30, National Health and Nutrition Examination Survey, 2009–2016

	Depression in Past 2 Weeks			
	Unadjusted Model		Adjusted Model	
Covariate	OR (95% CI)	*P* Value	AOR (95% CI)	*P* Value[a]
Ever have trouble sleeping				
No	1 [Reference]		1 [Reference]	
Yes	4.36 (3.06–6.21)	<.001	4.11 (2.78–6.06)	<.001
Age, y				
20–25	1.57 (1.09–2.26)	.01	1.39 (0.99–1.97)	.06
26–30	1 [Reference]		1 [Reference]	
Race/ethnicity				
Hispanic	0.74 (0.47–1.17)	.19	0.70 (0.43–1.15)	.15
Non-Hispanic white	1 [Reference]		1 [Reference]	
Non-Hispanic black	1.34 (0.91–1.98)	.13	1.08 (0.68–1.71)	.74
Other race	0.58 (0.28–1.22)	.15	0.69 (0.31–1.59)	.39
Education				
<High school graduate	4.14 (1.95–8.78)	<.001	2.32 (0.94–5.72)	.07
High school graduate	3.97 (1.97–8.00)	<.001	2.00 (0.93–4.29)	.08
Some college	3.24 (1.75–5.98)	<.001	1.88 (1.01–3.45)	.046
≥College graduate	1 [Reference]		1 [Reference]	
Marital status				
Married/living together	1 [Reference]		1 [Reference]	
Widowed/divorced/separated	2.88 (1.37–6.05)	.006	2.46 (1.08–5.62)	.03
Never married	1.77 (1.15–2.73)	.01	1.74 (1.03–2.94)	.04
Family size				
1 or 2	0.82 (0.51–1.29)	.38	0.89 (0.53–1.49)	.67
3 or 4	1.18 (0.75–1.84)	.47	1.17 (0.71–1.95)	.53
≥5	1 [Reference]		1 [Reference]	
Percentage of federal poverty level				
<100	2.89 (1.76–4.75)	<.001	1.86 (1.02–3.38)	.04
100–199	2.39 (1.37–4.15)	.003	1.67 (0.87–3.19)	.12
200–299	1.51 (0.76–3.00)	.23	1.30 (0.58–2.92)	.52
≥300	1 [Reference]		1 [Reference]	
Has health insurance				
No	1 [Reference]		1 [Reference]	
Yes	0.57 (0.41–0.79)	.001	0.65 (0.42–0.98)	.04
Has diabetes				

Abbreviations: AOR, adjusted odds ratio; CI, confidence interval; OR, odds ratio.
[a] *P* values were determined by *t* test.

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Table 3. Odds Ratios and Confidence Intervals for the Logistic Regression Estimate for the Relationship Between Ever Trouble Sleeping and Depression in Past 2 Weeks Among Women Aged 20–30, National Health and Nutrition Examination Survey, 2009–2016

	Depression in Past 2 Weeks			
	Unadjusted Model		Adjusted Model	
Covariate	OR (95% CI)	*P* Value	AOR (95% CI)	*P* Value[a]
No	1 [Reference]		1 [Reference]	
Yes	5.62 (1.81–17.4)	.003	3.99 (1.06–15.1)	.04
Ever used marijuana				
No	1 [Reference]		1 [Reference]	
Yes	2.38 (1.51–3.77)	<.001	1.84 (1.09–3.12)	.02

Abbreviations: AOR, adjusted odds ratio; CI, confidence interval; OR, odds ratio.
[a] *P* values were determined by *t* test.

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ORIGINAL RESEARCH

Time-Varying Effects of Parental Alcoholism on Depression

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PEER REVIEWED

Abstract

Introduction
Children of alcoholic parents are at increased risk for lifetime depression. However, little is known about how this risk may change in magnitude across age, especially in mid-adulthood and beyond.

Methods
We used a nationally representative sample (N = 36,057) of US adults from the National Epidemiologic Survey on Alcohol and Related Conditions, wave III. After adjusting for demographic characteristics, we examined the relationship between parental alcoholism and outcomes of 1) major depressive disorder, Diagnostic and Statistical Manual of Mental Disorders-5th edition (DSM-5) and 2) DSM-5 persistent depressive disorder. To examine continuous moderation of this relationship across participants' age, we used time-varying effect models.

Results
Parental alcoholism was associated in general with a higher risk for both major depressive disorder (odds ratio [OR], 1.98, 95% confidence interval [CI], 1.85–2.11; $P < .001$) and persistent depressive disorder (OR, 2.28, 95% CI, 2.04–2.55; $P < .001$). The association between parental alcoholism and major depressive disorder was stable and positive across age, but the association with persistent depressive disorder significantly declined among older adults; respondents older than 73 years old were not at increased risk for persistent depressive disorder.

Conclusions
Findings from this study show that the risk of parental alcoholism on depression is significant and stable among individuals of a wide age range, with the exception of a decline in persistent depressive risk among older adults. These findings highlight the importance of screening for depression among adults with parental alcoholism.

Introduction

Parental alcoholism has various negative physical, mental, and social consequences. Chief among these is depression; offspring of alcoholics are at heightened risk of depressive mood symptoms (1,2). The evidence for heightened depression among those exposed to parental alcoholism is particularly strong among young, college-aged adults (3,4).

Much of the research on the association between parental alcoholism and depression focuses on the question of resilience among adult children of alcoholics; that is, whether these individuals are ever able to overcome the challenges of parental alcoholism. Although some evidence suggests that older adults (those in their late 20s and early 30s) are more resilient than are young adults (those aged 18 through their early 20s) (5), there is little research on the effects of parental alcoholism among offspring of alcoholics in mid- to late adulthood, making their longer-term resilience unknown. Furthermore, the question of increased resilience at older ages assumes that the magnitude of the effect of parental alcoholism changes with increasing age; however, such age-varying effects have not yet been examined.

This study examined 1) the association between parental alcoholism and lifetime outcomes of both major depressive disorder (MDD) and persistent depressive disorder (PDD) among a full range of adults after controlling for demographic characteristics and 2) the age-varying effects of these associations (ie, how they may change in strength across participants' ages). We used data from wave III of the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC-III), a large nationally representative data set.

Methods

NESARC-III was sponsored, designed, and directed by the National Institute on Alcohol Abuse and Alcoholism (NIAAA) and conducted during 2012–2013. NESARC-III is a nationally representative sample of the civilian noninstitutionalized population of the United States aged 18 years or older; it had a 61.1% response rate and an original sample size of 36,309. The NIAAA collected information via questionnaires on alcohol and drug use and disorders, related risk factors, and associated physical and mental disabilities on the basis of NIAAA's Alcohol Use Disorder and Associated Disabilities Interview Schedule. This study excluded respondents with missing information on parental alcoholism; the final sample size for this study was 36,057. We used existing data from human participants in NESARC, and the study was approved by the University of North Dakota institutional review board. We completed the final analyses in May of 2016.

Measures

Parental alcoholism

Parental alcoholism was based on the self-reported answer to the question "Before you were 18, parent/other adult living in home was a problem drinker/alcoholic?" as a binary response variable (yes or no).

Depression

We analyzed 2 depressive disorders, lifetime MDD and lifetime PDD, as separate outcomes. Each outcome was derived from detailed self-reported responses to questionnaire items on the basis of corresponding criteria from the Diagnostic and Statistical Manual of Mental Disorders, 5th edition (DSM-5)(6). Briefly, lifetime MDD is characterized by one or more discrete episodes of at least 2 weeks during which respondents had either a depressed mood or a loss of interest in nearly all activities at some time during their adult lives (6). Lifetime PDD is a milder but more chronic form of depression and can be diagnosed when the mood disturbance continues for at least 2 years at some time during an adult's life (6). Both MDD and PDD exclude mood or anxiety disorders that are either substance-induced or due to a general medical condition.

Demographic characteristics

Age and sex were self-reported. Race/ethnicity was self-reported as white, black, Hispanic, American Indian, or Asian. Full-time employment was self-reported as working 35 or more hours per week or less than 35 hours per week.

Marital status was self-reported according to 6 response options, which were re-categorized as currently married (ie, married or living with someone as if married), not currently married (ie, widowed, divorced, or separated), and never married.

Education was self-reported with 14 response levels ranging from "no formal schooling" to "completed Master's degree or higher," and we re-categorized these into 3 levels: less than a high school diploma, high school diploma, and some college or more.

Annual household income was self-reported with 21 response categories ranging from less than $5,000 to $200,000 or more. We recoded these into a new numeric variable on the basis of midpoints of each category up to level 20; level 21 (≥$200,000) was recoded as $250,000, which is approximately the median income among households earning $200,000 or more (7).

Statistical analyses

We conducted weighted regressions using the statistical software R (The R Foundation) and its survey package to examine the association between parental alcoholism and outcomes of MDD and PDD, after adjusting for demographic characteristics.

We used time-varying effect models (TVEMs), an extension of regression modeling that allows coefficients to vary continuously over time (8), to assess how the association between parental alcoholism and depression outcomes varied across age of participants. In other words, TVEMs examine moderation across some continuous measure of time (eg, historical time, age, time from event). TVEMs are spline-based regression models, which estimate a lower-order polynomial trend within equal intervals on the basis of user-specified number of knots, k. On the basis of established standards for this methodology (9), 10 knots were specified, and P-spline estimation, which automatically finds the most parsimonious model ($k \leq 10$), was used. We ran separate logistic TVEM models for outcomes of MDD and PDD after controlling for demographic characteristics. Each model included a time-varying intercept (to adjust for the overall prevalence of depression across age) and the time-varying predictor of age (to examine continuous moderation of the effect of parental alcoholism across ages). We performed TVEM analyses in SAS 9.3 (SAS Institute Inc) using a publicly available SAS macro (9), version 3.1.0. TVEM analyses were interpreted with respect to 1) overall significance of the effect at a given value of age (ie, whether the confidence bands overlap the odds ratio (OR) of 1.0), and 2) the change in the effect across different ages (ie, whether the confidence bands exclude each other at different ages). Although these methods of establishing significance are more conservative than conventional significance tests, we did this because P values were available only for time-invariant covariates.

Results

Approximately 23% of respondents (n = 8,407) reported parental alcoholism. Respondents who reported parental alcoholism were significantly more likely than adults who did not report parental alcoholism to meet DSM-5 criteria for both MDD (29.6% vs 17.7%, $P < .001$) and PDD (9.3% vs 4.4%, $P < .001$) (Table). People who reported parental alcoholism were slightly but significantly younger (mean age, 44.8 y vs 45.9 y, $P < .001$); were more likely to be female (59.4% vs 55.4%, $P < .001$); had lower annual household incomes (median $32,500 vs $37,500, $P < .001$); were less likely to be never married (25.8% vs 28.4%, $P < .001$); were more likely to be not currently married (27.6% vs 25.4%, $P < .001$); were more likely to be white (57.8% vs 51.4%) or American Indian (2.1% vs 1.2%); and were less likely to be black (18.2% vs 22.3%) or Asian (1.9% vs 5.9%). The 2 groups did not significantly differ by education level (approximately 15% had <high school diploma, 22% high school diploma, and 62% some college or more), or full-time employment status (approximately 43%).

Additionally, compared with respondents who did not report parental alcoholism, those who reported parental alcoholism were slightly but significantly younger when they first had the first episode of MDD (median age, 27.8 y vs 30.5 y, $P < .001$) and PDD (median age, 27.9 y vs 30.6 y, $P < .001$) and had a significantly higher number of MDD episodes (median no., 4.6 vs 3.5, $P < .001$) and a nonsignificantly higher number of PDD episodes (median no., 2.1 vs 1.9). Respondents who reported parental alcoholism also talked to any health professional or therapist significantly more often to help improve their mood caused by MDD (63% vs 58%, $P < .001$) and nonsignificantly more often to help improve their mood caused by PDD (68% vs 64%) compared with respondents who did not report parental alcoholism. Respondents who reported parental alcoholism were significantly more likely to have symptoms of suicidal ideation (13% vs 8%, $P < .001$) and also meet DSM-5 criteria for other mental comorbidities such as anxiety (21% vs 11%, $P < .001$), personality disorders (27% vs 12%, $P < .001$), eating disorders (3% vs 1.5%, $P < .001$), substance use disorders (57% vs 37%, $P < .001$), and posttraumatic stress (12% vs 5%, $P < .001$).

Weighted regression analyses showed that parental alcoholism was associated with an approximately twofold increase in the odds of both MDD (OR, 1.84; 95% confidence interval [CI], 1.72–1.96; $P < .001$) and PDD (OR, 2.11; 95% CI, 1.88–2.37; $P < .001$), after controlling for demographics.

Parental alcoholism had a positive and stable effect on MDD across individuals throughout most of the age range of respondents aged 18 to 85 years (Figure 1). Participants between these ages were approximately 2 times as likely to have MDD as were participants who reported no parental alcoholism. Because of the small sample size of participants older than 85 years and the resulting widening of the confidence band (ie, the lower limit of the confidence band is less than the OR of 1), the relationship was no longer significant among these individuals, even though the point estimate remained stable.

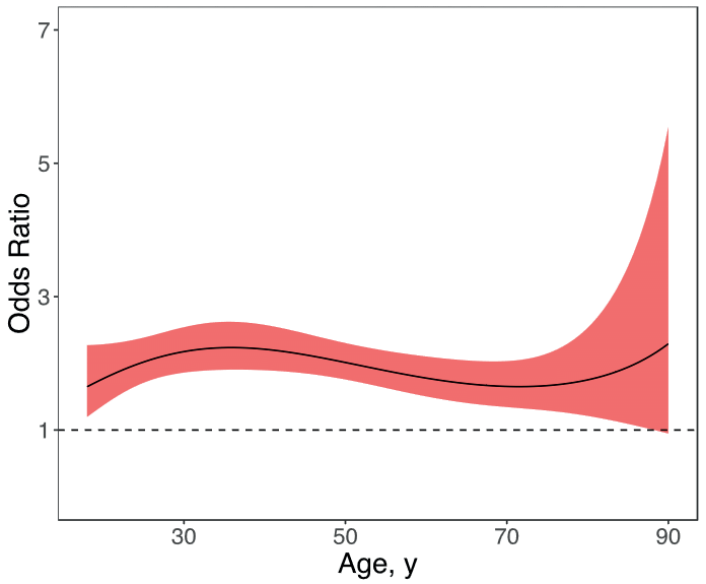

Figure 1. Age-varying effects of parental alcoholism on lifetime major depressive disorder for respondents aged 18–90 years, National Epidemiologic Survey on Alcohol and Related Conditions, Wave III, 2012–2013. Age-varying effects are presented as odds ratios (ORs) across ages; the solid line represents the OR point estimates, and the surrounding shading represents 95% confidence intervals. The horizontal line represents an OR of 1.00.

Similarly, parental alcoholism had a positive effect on PDD across a wide age range (Figure 2). Participants aged 18 to 73 years were approximately 2 times as likely to have PDD as were participants who reported no parental alcoholism. The association was nonsignificant for those aged 74 years and older. Additionally, the effect of parental alcoholism among older individuals (eg, OR of 0.8 for participants aged 80 y) was significantly weaker than the effect among younger individuals (eg, OR of 2.3 for participants aged 60 y).

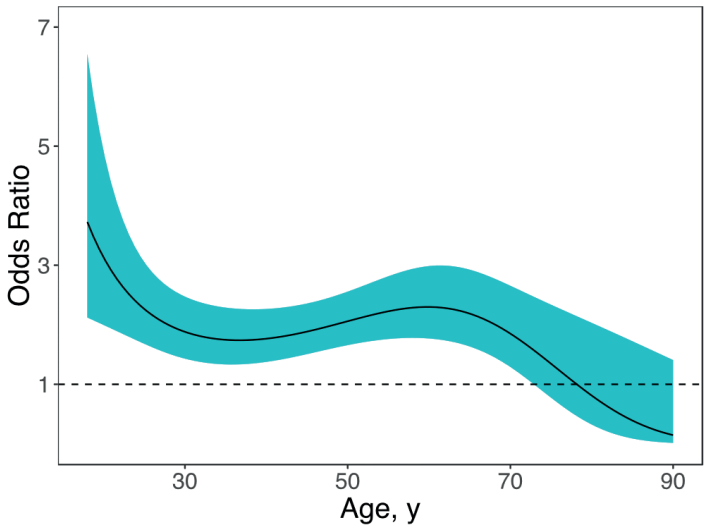

Figure 2. Age-varying effects of parental alcoholism on lifetime persistent depressive disorder for respondents aged 18–90 years, National Epidemiologic Survey on Alcohol and Related Conditions, Wave III, 2012–2013. Age-varying effects are presented as odds ratios (ORs) across ages; the solid line represents the OR point estimates, and the surrounding shading represents 95% confidence intervals. The horizontal line represents an OR of 1.00.

Discussion

This study examined how the relationship between parental alcoholism and depression outcomes may change across individuals of different ages. Respondents who reported being exposed to parental alcoholism as children had approximately twice the risk of meeting criteria for lifetime MDD and PDD. Parental alcoholism had a positive and stable effect on the odds of lifetime MDD throughout most of the age range of the participants, although this association was no longer significant for those aged 85 years old or older. However, although the association with PDD was positive and stable across individuals in early and late adulthood, it significantly decreased in strength for those older than 73, such that parental alcoholism was no longer associated with a heightened risk for PDD.

Results of this study also showed that 23% of adults had a parent with alcohol problems before the age of 18; the 1988 National Health Interview Survey estimated that 18.1% of adults had a parent with alcohol problems before the age of 18 (10). Although there is a large gap in timeline, the prevalence of adults growing up with a parent with alcohol problems seems comparable. Although current data on the prevalence of adults who grew up with a parent with alcohol problems are not available, it is estimated that an annual average of 7.5 million US children (10.5% of all children) live with a parent who had an alcohol use disorder in the past year (11). Although this figure is lower than we report here, it includes only past-year alcohol use disorder, a severe form of problem drinking. Hence, assuming that this prevalence will increase under NESARC's inclusion of other, less severe forms of problem drinking, the current prevalence rates are more consistent with those of previous reports.

Our findings confirm those of previous research that established that parental alcoholism is associated with an increased risk of depression among offspring (2,12,13). This study also extends this research in 2 important ways, given that many previous studies are limited to younger adults (2,3). Here, we examined the effects of parental alcoholism on depression among adults across a wide age range, and we rigorously examined the age-varying effects of parental alcoholism, showing that its effect is largely stable across individuals from early to late adulthood.

This study has limitations. First, the measure of parental alcoholism is limited in several ways. The single question that assessed parental alcoholism was proxy-reported by offspring. As a result, both the timing and the nature of the question may have created recall bias, in which those with depression are more likely to remember the drinking of their parents as problematic than those with no depression. Additionally, the wording of the question included parents as well as non-parental adults living in the household, although most participants reported living only with one or more biological parents. Thus, the wording of this question may have affected the results in unknown ways. Second, this study used cross-sectional data and thus cannot conclude that parental alcoholism causes depression among offspring.

Third, because we used cross-sectional data, the findings do not distinguish between true age and cohort when considering the age-varying effect of parental alcoholism. A true age-varying effect would capture data on the change in the effect of parental alcoholism as an individual ages, but these analyses examined the effect across individuals of different ages. This analysis introduces a cohort effect: the association between parental alcoholism and depression may change across individuals born in different years as a result of differences across time periods in, for example, the prevalence of parental alcoholism, the threshold at which participants consider alcohol consumption "problem drinking," the prevalence of depression, or other associated risk and protective factors. It is likely that both an age effect (5) and a cohort effect (14,15) contribute to our findings, but this study cannot distinguish between them. Thus, the findings should not be interpreted as effects for a given individual across time. Future studies using longitudinal data are needed to separate true age-varying effects from cohort effects.

Strengths of this study include the large, nationally representative sample, the use of rigorous and well-validated DSM-5 measures of MDD and PDD, and the use of TVEMs, an innovative methodology for examining continuous moderation across age.

Parental alcoholism is stably associated with depression outcomes among offspring across a range of ages from early to late adulthood, with a decline in PDD among older adults. This finding implies that the effect of parental alcoholism on PDD may weaken among older adults (aged ≥60 y), making them more resilient than middle-aged and younger adults for PDD. Conversely, we found no evidence of resilience to MDD, as shown by a similar effect across ages. Despite this long-term effect of parental alcoholism, many adults with depression do not seek treatment because of a desire for self-reliance and the perceived stigma of mental health difficulties (16). Children of alcoholics often desire secrecy about their parents' alcoholism (17), and this additional stigma may further compound the lack of treatment seeking among adult offspring of alcoholics. Our findings highlight the importance of screening for depression among offspring of alcoholics in health care settings to provide them with services and support to ultimately manage this mental health burden.

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Table

Table. Descriptive Statistics of Sample (N = 36,057), Study on Effects of Parental Alcoholism on Depression, National Epidemiological Survey on Alcohol and Related Conditions, Wave III, 2012–2013

Measure	Parental Alcoholism[a]	
	Yes	No
Major depressive disorder[b]	29.6	17.7
Persistent depressive disorder[b]	9.3	4.4
Median (IQR), age, y[c]	44.0 (32–56)	44.0 (30–59)
Sex[b]		
Female	59.4	55.4
Male	40.6	44.6
Education		
<High school diploma	15.7	14.8
High school diploma	22.4	22.7
Some college or more	61.9	62.4
Median (IQR) annual household income, $[c]	32,500 (17,500–65,000)	37,500 (17,500–65,000)
Full-time employment (≥35 h/wk)	43.2	44.2
Marital status		
Currently married	46.6	46.2
Not currently married[b]	27.6	25.4
Never married[b]	25.8	28.4
Race/ethnicity		
White[b]	57.8	51.4
Black[b]	18.2	22.3
American Indian[b]	2.1	1.2
Asian[b]	1.9	5.9
Hispanic	19.9	19.2

Abbreviation: IQR, interquartile range.

[a] Numeric variables presented as median (IQR), and categorical variables presented as percentages.

[b] χ^2 significant in parental alcoholism status at $P < .05$. MDD is characterized by discrete episodes of at least 2 weeks during which respondents experienced either depressed mood or a loss of interest in nearly all activities in adults at some time in their lives. Lifetime PDD is a milder but more chronic form of depression and can be diagnosed when the mood disturbance continues for at least 2 years in adults at some time in their lives (6).

[c] Analysis of variance significant in parental alcoholism status at $P < .05$.

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ORIGINAL RESEARCH

Differences by Sex in Association of Mental Health With Video Gaming or Other Nonacademic Computer Use Among US Adolescents

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PEER REVIEWED

Abstract

Introduction

Although numerous studies have examined the association between playing video games and cognitive skills, aggression, and depression, few studies have examined how these associations differ by sex. The objective of our study was to determine differences by sex in association between video gaming or other nonacademic computer use and depressive symptoms, suicidal behavior, and being bullied among adolescents in the United States.

Methods

We used data from the 2015 Youth Risk Behavior Survey on 15,624 US high school students. Rao–Scott χ^2 tests, which were adjusted for the complex sampling design, were conducted to assess differences by sex in the association of mental health with video gaming or other nonacademic computer use.

Results

Approximately one-fifth (19.4%) of adolescents spent 5 or more hours daily on video gaming or other nonacademic computer use, and 17.9% did not spend any time in those activities. A greater percentage of female adolescents than male adolescents reported spending no time (22.1% and 14.0%, respectively) or 5 hours or more (21.3% and 17.5%, respectively) in gaming and other nonacademic computer use ($P < .001$). The association between mental problems and video gaming or other nonacademic computer use differed by sex. Among female adolescents, prevalence of mental problems increased steadily in association with increased time spent, whereas the pattern for male adolescents followed a J-shaped curve, decreasing initially, increasing slowly, and then increasing rapidly beginning at 4 hours or more.

Conclusion

Female adolescents were more likely to have all 3 mental health problems than male adolescents were. Spending no time or 5 hours or more daily on video gaming or other nonacademic computer use was associated with increased mental problems among both sexes. As suggested by the J-shaped relationship, 1 hour or less spent on video gaming or other nonacademic computer use may reduce depressive symptoms, suicidal behavior, and being bullied compared with no use or excessive use.

Introduction

According to the Entertainment Software Association, in 2016, 63% of American households had at least one person who played video games regularly for 3 or more hours per week, and 27% of players were aged 18 years or younger (1). The average number of hours spent playing games continues to increase. According to Nielsen, time spent playing video games increased from 5.1 hours per week per person in 2011 to 6.3 hours in 2013 (2).

Internet use among adolescents has increased exponentially in the last decade (3). According to Common Sense Media, in 2015, American teenagers aged 13 to 18 spent an average of 3.5 hours per day on the Internet playing mobile games, watching online videos, using social network sites, chatting, and browsing websites. Moreover, 67% of teenagers owned a smartphone in 2015 (4). Growing ownership of smartphones has influenced the increase in Internet use over time.

Many studies showed that playing video or computer games and using the Internet for nonacademic purposes are associated with social behavior and have examined related health implications for adolescents; however, study results were contradictory. Some studies found that playing games was helpful in improving personality and networks of academic friendships, improving mood, and decreasing stress (5–11). Meta-analytic reviews found that playing violent video games was linked to aggressive behavior and decreased empathy (12–14). Playing violent video games was significantly associated with numerous symptoms of depression among pre-adolescents (15,16). Internet addiction among adolescents, including addiction to social network sites, was also related to sadness, suicide, distress, functional impairment, and cyberbullying (3,17–19).

Researchers and health professionals are concerned about depression, suicide and suicidal behavior, and bullying among children and adolescents (20–22). Being bullied is related to depression, mental illness, violent and aggressive behavior, and suicidal ideation (23–25). Adolescent depression and other mental disorders are chronic health conditions that can continue into adulthood (26). Depression is associated with suicide, and suicide among people aged 15 to 24 years was the third leading cause of death in United States in 2015 at a rate of 12.5 per 100,000 (27).

Although numerous studies have assessed the association between playing video games or other nonacademic computer use and aggression and depression, few studies have examined differences by sex in the relationship between playing video games or other nonacademic computer use and mental health among children and adolescents. Thus, the purpose of this study was to determine how the association between playing video or computer games or other nonacademic computer use (watching online videos, using social network sites, chatting, and browsing websites) and mental health (depressive symptoms, suicidal behavior, being bullied at school or cyberbullied) differs by sex among US adolescents.

Methods

We used data on 15,624 adolescents from the 2015 Youth Risk Behavior Survey (YRBS), administered by the Centers for Disease Control and Prevention. YRBS, which has been conducted biennially since 1991, uses a 3-stage cluster-sampling design to monitor priority health-risk behaviors among nationally representative samples of private school and public school students in grades 9 through 12 in the United States. In 2015, the sample size was 15,624, the school response rate was 69%, the student response rate was 81%, and the overall response rate was 60%.

Depressive symptoms were defined as the presence of feelings of sadness or hopelessness in response to the question, "During the past 12 months, did you ever feel so sad or hopeless almost every day for two weeks or more in a row that you stopped doing some usual activities?"

Students were questioned on 2 types of bullying: school bullying and cyberbullying. The school bullying question was "During the past 12 months, have you ever been bullied on school property?" with a yes/no answer option. The cyberbullying question was "During the past 12 months, have you ever been electronically bullied? (Include being bullied through e-mail, chat rooms, instant messaging, Web sites, or texting)," also with a yes/no answer option. Being bullied was defined as either being bullied at school or being cyberbullied.

Students were also asked 3 questions related to suicide: had they considered suicide, made a suicide plan, or attempted suicide. The question about considering suicide was "During the past 12 months, did you ever seriously consider attempting suicide?" with a yes/no answer option. The question about making a suicide plan was "During the past 12 months, did you make a plan about how you would attempt suicide?" also with a yes/no answer option. The question about attempting suicide was "During the past 12 months, how many times did you actually attempt suicide?" with response category options of 0 times, 1 time, 2 or 3 times, 4 or 5 times, or 6 or more times. Suicidal behavior was defined as answering yes to the questions about considering suicide or making a suicide plan or if the respondent reported having attempted suicide at least once in the past 12 months.

Engaging in video gaming or other nonacademic computer use was assessed with the question, "On an average school day, how many hours do you play video or computer games or use a computer for something that is not school work? (Count time spent on things such as Xbox, PlayStation, an iPod, an iPad or other tablet, a smartphone, YouTube, Facebook or other social networking tools, and the Internet)." Response options were none, 1 hour or less, 1 hour, 2 hours, 3 hours, 4 hours, and 5 or more hours.

Adjusted and weighted prevalence rates were measured by using a weighting factor in the YRBS to provide nationally representative estimates and by using PROC SURVEYFREQ in SAS version 9.4 (SAS Institute, Inc) to account for the complex 3-stage cluster sampling design. A weighting factor in YRBS data adjusted for school and student nonresponse, sex, grade, and race/ethnicity. Rao–Scott χ^2 tests, which were adjusted for the complex sampling design by using PROC SURVERYFREQ, were conducted to assess any differences by sex in time spent on video gaming or other nonacademic computer use, depressive symptoms, suicidal behavior, and being bullied and any differences by sex in the associ-

ation between time spent on video gaming or other nonacademic computer use with depressive symptoms, suicidal behavior, and being bullied. A 2-sided *P* value of <.05 was considered significant.

Results

Among the sample of 15,624 adolescents, 51.3% were male and 48.7% were female. One in 5 adolescents spent 5 hours or more per day playing video or computer games or used a computer for something unrelated to school work. Almost one-fifth (17.9%) did not engage in playing videos or computer games or other nonacademic computer use. A greater percentage of female adolescents than male adolescents reported no time or 5 hours or more spent in gaming or other nonacademic computer use ($P < .001$) (Table 1).

A significantly higher prevalence of depressive symptoms, suicidal behavior, and being bullied was observed among female adolescents than male adolescents (Table 1). Approximately 1 in 3 adolescents had depressive symptoms; 1 in 5 had considered suicide, made a suicide plan, or attempted suicide; and 1 in 4 had been bullied at school or had been cyberbullied. The prevalence of depressive symptoms, suicidal behavior, and being bullied differed significantly by sex ($P < .001$ for each mental health problem). Female adolescents were nearly twice as likely to have depressive symptoms, suicidal behavior, and to have been bullied than male adolescents.

A pattern of change in the prevalence of depressive symptoms, suicidal behavior, and being bullied in relation to time spent on video gaming or other nonacademic computer use had a J-shaped curve (Figure). Prevalence decreased initially, then increased slowly, and then increased rapidly from 4 hours or more. Those spending 5 or more hours per day on video games or other nonacademic computer use had the highest prevalence of depressive symptoms (43.1%), suicidal behavior (32.4%), and being bullied (31.5%). The lowest prevalence of depressive symptoms (22.8%) and being bullied (21.9%) was among those spending less than 1 hour, and the lowest prevalence of suicidal behavior was among those spending 1 hour (15.7%).

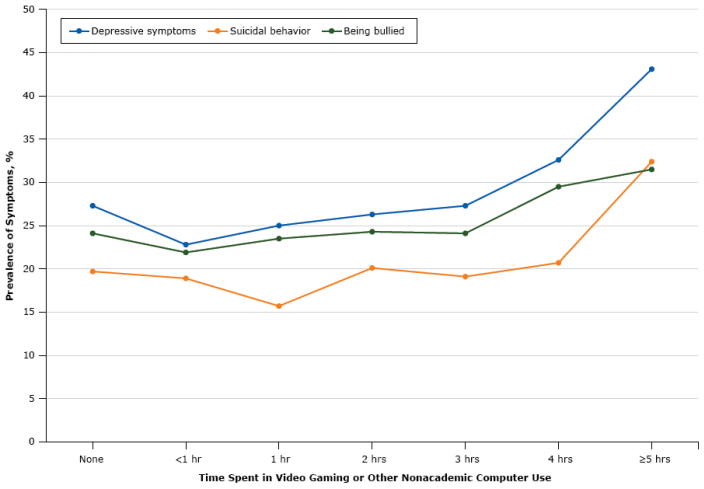

Figure. Prevalence of depressive symptoms, suicidal behavior, and being bullied in relation to time spent on video gaming or other nonacademic computer use among male and female adolescents, Youth Risk Behavior Survey, 2015.

The relationship between mental health and hours spent in video gaming or other nonacademic computer use varied by sex and type of mental health problems (Table 2). The percentage of female adolescents experiencing depressive symptoms with no time spent in video gaming or other nonacademic computer use was 32.7%, rose to 33.3% for less than 1 hour spent, fell to 32.7% for 1 hour spent, and then rose steadily to a peak of 53.8% at 5 or more hours spent ($P < .001$). Prevalence among male adolescents was 19.0% for no time spent in video gaming or other nonacademic computer use, fell to 16.1% for less than 1 hour, than rose to 30.3% for 5 hours or more ($P < .001$). For suicidal behavior among female adolescents, prevalence was 22.5% at no hours spent and rose to 37.8% at 5 or more hours spent. For male adolescents, prevalence was 14.9% for no hours spent and rose to 25.1% for 5 or more hours spent. Female adolescents who spent no time in video gaming or other nonacademic computer use had a prevalence of 27.3% of being bullied and 36.8% at 5 or more hours spent. For male adolescents, the prevalence of being bullied was 19.0% at no time spent, fell to 15.3% for less than 1 hour spent, and then rose to 25.5% for 5 or more hours spent. For all mental health problems and both sexes, prevalence fluctuated up and down between less than 1 hour and 5 or more hours and generally increased beginning at 4 hours.

Discussion

Our study examined differences between male and female adolescents in time spent video gaming or other nonacademic computer use, depressive symptoms, being bullied, and suicidal behavior

and any differences by sex in the association of time spent in video gaming or other nonacademic computer use with depressive symptoms, being bullied, and suicidal behavior. Our study provided evidence of the J-shaped relationship between video gaming or other nonacademic computer use and depressive symptoms, suicidal behavior, and being bullied among US adolescents. Adolescents who spent 5 hours or more in video gaming or other nonacademic computer use had the highest rates of depressive symptoms, suicidal behavior, and being bullied. The lowest rates were among adolescents spending less than 1 hour or 1 hour. Adolescents who did not play video or computer games or use the computer for nonacademic reasons had higher rates than those who spent 1 hour or less per day. However, female adolescents were almost twice as likely to experience depressive symptoms, suicidal behavior, or being bullied in relation to time spent playing video games or in other nonacademic computer use than male adolescents.

One study found similar results about the relationship between video gaming or other nonacademic computer use and suicide by using the 2007 and 2009 YRBS (19). That study found that 5 hours or more of daily video gaming or other nonacademic computer use was associated with higher risk of sadness, suicidal ideation, and suicidal planning than no time spent. The same study also found that 1 hour or less of daily video gaming had potentially protected against 2-week sadness compared with no video gaming. However, that study did not investigate differences by sex in the associations. It also did not investigate the association between being bullied and daily video gaming or other nonacademic computer use. Because Internet technologies have developed rapidly, adolescents are able to easily acquire information, and they have many ways, such as social network sites, to communicate with others online, which may suggest that adolescents are more likely to be at risk of being bullied, especially of being cyberbullied. Our study consistently showed that adolescents who spent 4 hours or more daily on video games or other nonacademic computer use were 1.5 times more likely to be bullied than those who spent 3 hours or less.

Two studies, Belanger et al and Kim, found a U-shaped association between Internet use for nonacademic purposes and mental health among Swiss and Korean adolescents, respectively (28,29). Both studies suggested that health professionals should be alert to heavy Internet use (≥2 h/d) and to no use as indicators of high risk for mental disorders. However, both studies defined heavy use as spending 2 hours or more daily on the Internet. Because Belanger et al used data from 2002 and Kim used data from 2009, their categories for intensity of Internet use are not relevant to recent trends, which were reported in 2015 at 3.5 hours per day on average for US adolescents, including playing mobile games, watching online videos, using social network sites, chatting, and browsing websites (4).

Although YRBS data have the advantage of being a nationally representative sample of adolescents, our study has several limitations. First, because YRBS consists of cross-sectional data, assessing the cause–effect relationship between video gaming or other nonacademic computer use and mental problems was not possible. Second, investigating the association of mental problems with video gaming or other nonacademic computer use separately was not possible. Although video gaming and other nonacademic computer use are different measures, YRBS uses a single variable for the 2 activities. However, studies have demonstrated differences between the 2 measures. For example, in one study, 62% of male adolescents enjoyed playing video games, compared with 20% of female adolescents, and 44% of female adolescents enjoyed using social media, compared with 29% of male adolescents (4). Moreover, on average, female adolescents spent about 40 minutes more on social network sites than male adolescents (4). Further research is warranted for establishing a separate measure each for video gaming and other nonacademic computer use to determine their relation to mental health.

Our study found that video gaming or other nonacademic computer use among US adolescents for 5 hours or more daily was significantly associated with increases in depressive symptoms, suicidal behavior, and being bullied. The prevalence of each of the 3 mental health problems was higher among female adolescents than among male adolescents. As suggested by the J-shaped relationship, 1 hour or less of playing video games or other nonacademic computer use may reduce the prevalence of these mental health problems whereas nonuse or excessive use may increase them. Therefore, sex-specific intervention programs should be developed. Furthermore, because our data show that some video gaming and other nonacademic computer use may reduce the prevalence of depressive symptoms, suicidal behavior, and being bullied, public health professionals may want to shift mindfulness intervention programs toward eHealth or mHealth technologies rather than completely dismissing the activities. Use of technology for health promotion and disease prevention has advanced rapidly through the emergence of eHealth and mHealth technologies. Both technologies offer several advantages over traditional, in-person methods of health promotion and disease prevention interventions. Both are cost efficient and interactive and can automate delivery of interventions, thereby enabling real-time assessments, personalizing and tailoring content, and reaching larger

populations and hard-to-reach subgroups than conventional methods (30). Sex-specific mindfulness intervention programs that use these technologies in conjunction with video games and other nonacademic computer use may be well received by adolescents as well as by their parents and teachers.

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Tables

Table 1. Prevalence of Time Spent in Video Gaming and Other Nonacademic Computer Use[a] and Mental Problems Among Students (N = 15,624), by Sex, 2015 Youth Risk Behavior Survey

Variable[b]	Total, %	Female, %	Male, %	*P* Value[c]
Time spent, h				
None	17.9	22.1	14.0	<.001
<1	13.8	10.9	16.5	
1	10.8	10.4	11.2	
2	15.8	13.8	17.7	
3	13.4	12.8	14.0	
4	8.9	8.7	9.1	
≥5	19.4	21.3	17.5	
Mental problems				
Depressive symptoms	29.9	39.8	20.3	<.001
Suicidal behavior	21.7	27.3	16.1	<.001
Being bullied	25.7	32.2	19.6	<.001

[a] Nonacademic computer use includes playing mobile games, watching online videos, using social network sites, chatting, and browsing websites.
[b] Values are adjusted and percentages are weighted unless otherwise noted.
[c] Calculated by using the Rao–Scott χ^2 test.

Table 2. Prevalence of Mental Problems by Time Spent in Video Gaming and Other Nonacademic Computer Use[a] Among Students (N = 15,624), by Sex, 2015 Youth Risk Behavior Survey

Variable	No. of Hours Spent, %[b]							*P* Value[c]
	None	<1	1	2	3	4	≥5	
Depressive symptoms								
Female	32.7	33.3	32.7	36.1	38.4	45.9	53.8	<.001
Male	19.0	16.1	18.1	18.9	17.3	20.6	30.3	
Suicidal behavior								
Female	22.5	25.9	19.5	26.1	25.4	28.5	37.8	<.001
Male	14.9	14.3	12.5	15.3	13.5	13.7	25.1	
Being bullied								
Female	27.3	32.2	30.4	33.0	29.3	37.4	36.8	<.001
Male	19.0	15.3	17.3	17.7	19.6	22.3	25.5	

[a] Nonacademic computer use includes playing mobile games, watching online videos, using social network sites, chatting, and browsing websites.
[b] Values are adjusted and percentages are weighted unless otherwise noted.
[c] Calculated by using the Rao–Scott χ^2 test.

PREVENTING CHRONIC DISEASE
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RESEARCH BRIEF

Correlation Between Personal Health History and Depression Self-Care Practices and Depression Screening Among African Americans With Chronic Conditions

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PEER REVIEWED

Abstract

Little is known about the influence of personal health history and depression self-care practices on screening for depression by health care providers among African Americans with chronic conditions. African Americans (N = 203) aged 18 years or older and living with at least one chronic health condition in a metropolitan city completed a 45-item community perceptions survey. The number of depression symptoms experienced per month was positively associated with screening for depression by a health care provider; perceived ability to identify depression symptoms was inversely associated with screening by a health care provider. Understanding patients' health history and self-care practices can initiate provision of information or support services to improve patient–provider communication about depression.

Objective

Forty-eight percent of adults in the United States living with one or more chronic conditions (eg, heart disease, cancer, diabetes, mood disorders) are African American (1,2). An area of concern is the co-existence of depression with a physical condition (3), but symptoms of depression often go unrecognized (4,5). Moreover, African Americans may be reluctant to discuss symptoms with health care providers for fear of being stigmatized (5–8).

We examined whether personal health history and depression self-care practices were associated with depression screening by health care providers among African Americans with chronic conditions. An analysis of community perceptions can inform development of culturally tailored messages encouraging patient–provider dialogue during medical appointments.

Methods

A convenience sample of 203 African Americans completed a cross-sectional survey about mental health services that was administered from January through April 2014. Inclusion criteria were being aged 18 years or older, having one or more physical chronic conditions, and living in Indianapolis at the time of survey distribution. Institutional review board approval (protocol no. 1312966930) was granted from Indiana University.

The survey consisted of 45 questions that measured indicators related to physical and mental health. Individuals' personal experiences accessing mental health services were also assessed. A panel of experts working in a primary care office, at a hospital mental health department, and at the state National Black Nurses Association reviewed the survey before distribution. Eligible participants at community centers, places of worship, barber shops, and community events completed the survey in approximately 10 minutes and received an incentive.

Of the 45 questions, 18 focused on depression screening, personal health history, and depression self-care practices. The outcome variable was having ever been screened for depression by a health care provider. Personal history with depression included number of poor mental health days and number of depression symptoms

per month. Perceptions toward depression self-care were assessed by 1) being able to make an appointment, 2) knowing who to call for personal or emotional problems, 3) being able to identify symptoms of depression, 4) being able to take an antidepressant medicine, 5) being able to make oneself feel better, and 6) being able to avoid difficult situations that can trigger depression. Perceptions were measured on a 5-point Likert scale of agreement (from 1 being strongly disagree to 5 being strongly agree). Participants provided demographic information, including sex, annual household income, education level, employment status, marital status, age, general health status, health insurance status, and number of chronic health conditions.

We calculated descriptive statistics on all variables. Pearson correlation analysis determined which demographic characteristics to include in the logistic regression analysis. Binary adjusted logistic regression determined factors associated with depression screening. Data were analyzed using SPSS version 23 (IBM Corporation). Significance was set at $P < .05$.

Results

Complete questionnaires were returned by 138 (68%) women and 65 (32%) men (Table 1). Approximately 37% (n = 75) of participants earned less than $10,000 per year, 58% (n = 118) had a high school diploma/general educational development certificate or some college, and 87% (n = 176) were insured. The mean age of participants was 53.9 years. Fifty eight percent (n = 118) reported never having been screened for depression. On average, participants had 2 chronic conditions and 2 symptoms of depression per month.

Demographic characteristics (income, employment, and number of chronic conditions) were not statistically associated with depression screening. Income and employment were negatively correlated with depression screening ($r = -0.15$, $P = .04$ and $r = -0.24$, $P = .001$). Participants who reported having one or more chronic conditions or self-identified symptoms of depression were more likely to be screened by a health care provider (Table 2). Number of chronic conditions was positively correlated with depression screening ($r = .31$, $P < .001$). For personal history with depression, results indicated that for one unit increase in the number of depression symptoms per month, participants were more likely to be screened for depression (odds ratio [OR] [95% confidence interval (CI)] = 1.71 [1.10–2.66]). Number of mental health days per month was not associated with depression screening. Among perceptions toward depression self-care measures, ability to identify symptoms of depression was associated with depression screening. For each increase on the perceived ability to identify symptoms of depression (ie, ability to identify symptoms of depression) participants were less likely to be screened for depression (OR [95% CI] = 0.27 [0.89–4.83]).

Discussion

This formative research offers new perspectives to explore help-seeking behaviors among African Americans with pre-existing chronic conditions. Mental health days per month is a vague concept that may be perceived as involving extreme fatigue (eg, "I need a mental health day."). Conversely, number of depression symptoms focuses on a specific condition and may prompt the patient or provider to inquire whether chronic condition(s) or depression are affecting daily activities. More research should be conducted on the meaning of these concepts from the perspective of the African American community. Culturally relevant messages can be developed to promote "check-ins" that prompt discussion as opposed to reprimand for noncompliant behavior.

Participants in this study, on average, visited a medical provider 5 times per month, which may place this sample at a higher probability of being screened. This factor is important given that depression screening is dependent on seeing a health care provider. Despite this finding, increased confidence to self-identify symptoms of depression equated to decreased likelihood that participants would talk to their medical provider. Studies demonstrate that African American patients do not initiate discussion because of perceptions that disclosure within primary care is not appropriate, fear of not having a choice in treatment decisions, and the emotional cost of talking about symptoms (9–11). Clinical–community partnerships involving African American churches can focus on creating culturally relevant spaces to conduct depression screenings.

Our study has limitations. First, the sample size was small, so findings cannot be generalized to the broader community. Second, we used self-reported data, which may be inaccurate because of recall bias or respondent bias. Third, data are were cross sectional, so causality could not be inferred. These limitations, however, do not outweigh the contribution of the study. This exploratory study underscores the necessity of exploring sociological factors that affect the initiation of preventive screenings in health care settings.

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Tables

Table 1. Demographic and Health Outcome Data of Study Population (N = 203)[a], Study on Correlation Between Personal Health and Depression Self-Care Practices and Being Screened for Depression Among African Americans, Community Perceptions Survey, Indianapolis, Indiana, 2014

Characteristic/Outcome	Value
Sex	
Female	138 (68.0)
Male	65 (32.0)
Mean age, y (SD)	53.9 (14.79)
Income, $	
<10,000	75 (36.9)
10,000–19,999	41 (20.2)
20,000–29,999	24 (11.8)
30,000–39,999	21 (10.3)
40,000–49,999	15 (7.4)
≥50,000	16 (7.9)
Education	
Less than high school	44 (21.7)
High school diploma/general educational development certificate	57 (28.1)
Some college	61 (30.0)
Technical school/college graduate	35 (17.2)
Employment	
Does not work	78 (38.4)
Employed	76 (37.4)
Student	8 (3.9)
Retired	41 (20.2)
Marital status	
Married	40 (19.7)
Divorced or separated	67 (33.0)
Widowed	24 (11.8)
Single	69 (34.0)
General health status	
Very good	29 (14.3)
Good	80 (39.4)
Fair	77 (37.9)
Poor	17 (8.4)
Health insurance status	
Insured	176 (86.7)
Not insured	27 (13.3)

Abbreviation: SD, standard deviation.
[a] Values are no. (%) unless otherwise indicated.

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Table 1. Demographic and Health Outcome Data of Study Population (N = 203)[a], Study on Correlation Between Personal Health and Depression Self-Care Practices and Being Screened for Depression Among African Americans, Community Perceptions Survey, Indianapolis, Indiana, 2014

Characteristic/Outcome	Value
Screened for depression	
Yes	82 (40.4)
No	118 (58.1)
Health outcome, mean (SD)	
No. of chronic conditions	2.05 (1.32)
No. of times visited a doctor per month	5.07 (7.07)
No. poor mental health days per month	5.91 (8.94)
No. of depressive symptoms per month	2.04 (1.89)

Abbreviation: SD, standard deviation.
[a] Values are no. (%) unless otherwise indicated.

Table 2. Logistic Regression of Socio-Demographic Factors Associated with Depression Screening, Study on Correlation Between Personal Health and Depression Self-Care Practices and Being Screened for Depression, Community Perceptions Survey, Indianapolis, Indiana, 2014

Variable	Odds Ratio (95% Confidence Interval)	Standard Error	*P* Value
Income, $			
<10,000			1 [Reference]
10,000–19,999	0.78 (0.13–4.64)	0.71	.79
20,000–29,999	0.74 (0.07–8.06)	0.90	.81
30,000–39,999	1.55 (0.12–2.90)	2.06	.74
40,000–49,9999	0.44 (0.04–4.61)	0.52	.49
≥50,000	2.19 (0.21–2.04)	2.63	.51
Employment			
Unemployed			1 [Reference]
Employed	0.38 (0.08–1.98)	0.32	.25
Student	0.60 (0.03–1.92)	0.89	.73
Retired	0.76 (0.09–6.75)	0.85	.81
Number of chronic conditions	1.30 (0.76–2.23)	0.36	.33
Personal history with depression			
Number of mental health days	0.999 (0.91–1.09)	0.04	.99
Number of symptoms per month	1.71 (1.10–2.66)	0.38	.02
Perceptions toward depression self-care			
How to make an appointment . . . get help	1.19 (0.35–1.98)	0.58	.72
Know who to call to get help right away	0.83 (0.07–0.99)	0.37	.68
Can you identify symptoms of depression	0.27 (0.89–4.83)	0.18	.049
How to take antidepressant medication or get counseling	2.08 (0.52–4.58)	0.89	.09
Make myself feel better by doing more pleasurable activities	1.55 (0.51–3.08)	0.86	.43
Can avoid difficult situations that can trigger depression	1.26 (0.05–2.58)	0.58	.62

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RESEARCH BRIEF

Using the Behavioral Risk Factor Surveillance System to Assess Mental Health, Travis County, Texas, 2011–2016

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PEER REVIEWED

Summary

What is already known on this topic?

Mood disorders, of which the most common is depression, are prevalent among US adults and can exacerbate many chronic health conditions.

What is added by this report?

We explored Behavioral Risk Factor Surveillance System (BRFSS) data as a tool for assessing mental health in a community. By assessing poor mental health in addition to diagnosed depression, we identified at-risk and potentially undiagnosed populations.

What are the implications for public health practice?

The finding that individuals reporting chronic conditions had a higher odds of reporting depression and poor mental health indicates that interventions must address chronic disease and poor mental health or diagnosed mental health conditions such as depression in tandem.

Abstract

The purpose of this study was to explore using BRFSS data to assess mental health in a community. We describe and compare adults reporting diagnosed depression and adults reporting poor mental health and the associations of chronic diseases with each condition in Travis County, Texas. Significant associations between each mental health condition and chronic diseases existed; however, demographics, risk behaviors, and health care access differed between those reporting depression and those reporting poor mental health. Assessing poor mental health in addition to diagnosed depression can identify at-risk and potentially undiagnosed populations.

Objective

An estimated 1 in 10 adults have some type of mood disorder, the most common being depression (1). Additionally, both mood disorder and depression can exacerbate many chronic health conditions (1–5). Therefore, identifying populations at risk for mental health conditions is important for prevention and management of chronic diseases. The objective of this study was to explore using Behavioral Risk Factor Surveillance System (BRFSS) data as a tool for assessing mental health in a community. We describe and compare adults who reported diagnosed depression and adults reporting poor mental health and the associations of chronic diseases with each condition in Travis County, Texas.

Methods

BRFSS is a federally supported landline and cellular telephone survey (6) and its data are often the only ones available to measure prevalence of chronic conditions and risk factors at a local population level. We used BRFSS data for Travis County residents from 2011 through 2016 to assess mental health status. BRFSS has 2 questions to assess mental health. Depression is measured by a yes/no response to the question "Has a doctor, nurse, or other health professional ever told you that you have a depressive disorder including depression, major depression, dysthymia, or minor depression?" Poor mental health is measured by a "none to less than 14 days" or "14 or more days" response to the question, "Now thinking about your mental health, which includes stress, depression, and problems with emotions, for how many days during the past 30 days was your mental health not good?" Demographic characteristics included race/ethnicity, sex, age, education, and income. Health care access was measured by whether respondents had a personal doctor. Self-reported risk factors included heavy drinking and smoking status.

Five chronic diseases were individually assessed for their association with each mental health condition. Cardiovascular disease, diabetes, obesity, and chronic obstructive pulmonary disease

(COPD) were measured by individuals reporting that they had been told by a health care professional they have the disease. Asthma was defined as having been told by a health care professional that they had asthma and reporting that they currently have asthma.

We stratified prevalence of depression and poor mental health by demographic characteristics, health care access, risk behaviors, and chronic disease. We used logistic regression models to determine associations between each chronic disease and depression or poor mental health, respectively, and adjusted for demographics (sex, age group, and race/ethnicity), having a personal doctor, smoking status, and heavy drinking. Significance for bivariate analysis was set at $P < .05$, and significance for multivariate analysis was set at $P < .01$.

Results

More adults reported diagnosed depression (16%) than poor mental health (10%) (Table 1). White respondents had the highest prevalence of diagnosed depression, and black respondents had the highest prevalence of poor mental health. Adults aged 45 to 64 reported the highest prevalence of diagnosed depression, and adults aged 18–44 reported the highest prevalence of poor mental health.

Respondents with a personal doctor had a higher prevalence of diagnosed depression than those without a personal doctor, and respondents without a personal doctor had a higher prevalence of poor mental health than respondents with one. In some cases, the population that reported depression and the population that reported poor mental health were similar (Table 1). Female respondents had a prevalence of diagnosed depression almost twice as high as male respondents and a prevalence of poor mental health that was nearly 1.5 times that of male respondents. Respondents with an annual income of less than $25,000 reported the highest prevalence of both depression and poor mental health compared with other income groups. Respondents who reported heavy drinking and current smoking had the highest prevalence of both diagnosed depression and poor mental health. Prevalence of depression and poor mental health were significantly higher among respondents with chronic health conditions than among individuals without these conditions (Table 1).

After controlling for demographic characteristics, risk behaviors, and having a personal doctor, the odds of reporting depression or the odds of reporting poor mental health were significantly higher for individuals reporting cardiovascular disease, diabetes, COPD, and asthma (Table 2).

Discussion

To our knowledge, this study is the first to describe using BRFSS data on diagnosed depression and poor mental health for a more complete assessment of mental health in a population. Although the terms are often used interchangeably, poor mental health and mental illness are not the same thing (1). However, poor mental health is a risk factor for undiagnosed mental health conditions, including depression, which is the most commonly diagnosed mental health condition. Temporary feelings of sadness and other symptoms that last longer than 2 weeks may be diagnosed as depression (7); therefore, more than 14 days of poor mental health in the past 30 days could indicate an undiagnosed mental health condition. Assessing poor mental health in addition to diagnosed depression can assist public health practitioners in determining populations who may be at risk for undiagnosed, untreated, or unmanaged mental health conditions.

Our study has limitations. Findings cannot be generalized to other locations; however, our methods offer practitioners a useful tool for assessing mental health and its associations with chronic disease in their areas. BRFSS data are self-reported and do not represent individuals without a telephone or mailing address; they are also subject to social desirability bias, especially as it relates to stigmatized conditions. Therefore, poor mental health and diagnosed depression may be underreported.

Our findings suggest that programs focusing on mental health in Travis County should ensure that they include black adults, younger adults, adults with lower education levels, and adults without a personal doctor. Access to care should be considered in assessing mental health in a population, because individuals without a personal doctor may not receive diagnosis or subsequent treatment. Additionally, the finding that individuals reporting chronic conditions had higher odds of reporting depression and poor mental health even after controlling for covariates emphasizes that interventions must address chronic disease and poor mental health or diagnosed mental health conditions such as depression in tandem.

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Tables

Table 1. Prevalence of Depression and Poor Mental Health by Demographic Characteristics, Health Care Access, Risk Behaviors, and Chronic Health Conditions, Adults in Travis, County, Texas, BRFSS 2011–2016

Category	Depression (N = 131,540)	Poor Mental Health (N = 79,652)
	% (95% Confidence Interval)	
Total population	16.4 (15.0–17.8)	10.0 (8.7–11.3)
Demographic Characteristics		
Race/ethnicity		
White	20.4[a] (18.4–22.4)	9.1 (7.7–10.4)
Black	16.0 (11.5–20.5)	15.5 (9.8–21.3)
Hispanic	9.8[a] (7.5–12.0)	8.8 (6.3–11.3)
Sex		
Female	20.7[a] (18.5–22.9)	11.8 (9.9–13.8)
Male	12.1[a] (10.2–13.9)	8.2 (6.6–9.9)
Age, y		
18–44	15.9 (13.6–18.1)	11.1[a] (9.1–13.1)
45–64	18.7[a] (16.5–20.8)	9.1 (7.5–10.8)
≥65	13.3[a] (11.3–15.4)	6.9[a] (5.0–8.8)
Education		
Less than high school graduate	12.6 (9.0–16.3)	10.9 (6.7–15.0)
High school graduate	16.3 (12.6–19.9)	14.1[a] (10.4–17.9)
Some college	17.2 (14.2–20.2)	11.3 (8.7–13.9)
College graduate	17.1 (15.2–19.0)	6.4[a] (5.2–7.7)
Annual income, $		
<25,000	21.0[a] (17.6–24.5)	16.3[a] (12.8–19.8)
25,000 to <75,000	16.8 (14.2–19.4)	9.5[a] (7.5–11.5)
≥75,000	14.3[a] (12.0–16.5)	5.8[a] (4.3–7.4)
Health Care Access		
Having a personal doctor		
Yes	17.1 (15.5–22.3)	9.2 (7.7–10.6)
No	14.7 (11.9–17.5)	11.7 (9.1–14.4)
Risk Behavior		
Heavy drinking[c]		
Yes	25.4[a] (19.0–31.9)	13.0 (7.6–18.3)
No	16.0[a] (14.4–17.5)	9.3 (8.0–10.7)

Abbreviations: BRFSS, Behavioral Risk Factor Surveillance System; COPD, chronic obstructive pulmonary disease.
[a,b] Nonoverlapping 95% confidence intervals were considered significant between groups within each category.
[c] Heavy drinking defined ≥15 drinks per week for men or ≥8 drinks per week for women.
[d] Cardiovascular disease includes coronary heart disease, angina, congestive heart failure, high blood pressure, and stroke; COPD includes chronic obstructive pulmonary disease, emphysema, or chronic bronchitis.

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Table 1. Prevalence of Depression and Poor Mental Health by Demographic Characteristics, Health Care Access, Risk Behaviors, and Chronic Health Conditions, Adults in Travis, County, Texas, BRFSS 2011–2016

Category	Depression (N = 131,540)	Poor Mental Health (N = 79,652)
	% (95% Confidence Interval)	
Smoking status		
Current	27.6[a] (22.4–32.8)	19.4[a,b] (14.8–24.0)
Former	21.9 (18.7–25.1)	8.8[a] (6.6–11.0)
Never	12.3[a] (10.7–14.0)	8.6[b] (7.0–10.2)
Chronic Health Conditions[d]		
Cardiovascular disease		
Yes	29.5[a] (23.3–35.8)	19.2[a] (12.3–26.1)
No	15.6[a] (14.1–17.1)	9.5[a] (8.2–10.8)
Diabetes		
Yes	24.3[a] (19.3–29.3)	13.1 (9.1–17.1)
No	15.7[a] (14.2–17.2)	9.8 (8.4–11.2)
Obesity		
Yes	19.4 (16.5–22.3)	13.2[a] (10.5–16.0)
No	16.0 (14.2–17.7)	8.7[a] (7.2–10.1)
COPD		
Yes	41.5[a] (32.1–50.9)	31.4[a] (21.1–41.7)
No	15.7[a] (14.1–17.3)	8.7[a] (7.3–10.0)
Asthma		
Yes	27.0[a] (20.3–33.8)	21.0[a] (14.0–28.1)
No	15.4[a] (14.0–16.8)	9.0[a] (7.8–10.3)

Abbreviations: BRFSS, Behavioral Risk Factor Surveillance System; COPD, chronic obstructive pulmonary disease.
[a,b] Nonoverlapping 95% confidence intervals were considered significant between groups within each category.
[c] Heavy drinking defined ≥15 drinks per week for men or ≥8 drinks per week for women.
[d] Cardiovascular disease includes coronary heart disease, angina, congestive heart failure, high blood pressure, and stroke; COPD includes chronic obstructive pulmonary disease, emphysema, or chronic bronchitis.

Table 2. Adjusted Odds of Reporting Depression and Poor Mental Health Among Adults With Each Chronic Condition, Travis County, Texas, BRFSS 2011–2016

Chronic Condition	Depression		Poor Mental Health	
	Adjusted OR[a] (95% CI)	*P* Value	Adjusted OR[a] (95% CI)	*P* Value
Cardiovascular disease[b]				
Yes	2.3 (1.6–3.4)	<.001	2.9 (1.6–5.1)	<.001
No	1 [Reference]		1 [Reference]	
Diabetes				
Yes	2.1 (1.6–3.0)	<.001	1.8 (1.2–2.7)	.003
No	1 [Reference]		1 [Reference]	
Obesity				
Yes	1.3 (1.0–1.7)	.02	1.7 (1.2–2.4)	<.001
No	1 [Reference]		1 [Reference]	
COPD[b]				
Yes	2.7 (1.7–4.2)	<.001	4.0 (2.3 –7.1)	<.001
No	1 [Reference]		1 [Reference]	
Asthma				
Yes	1.7 (1.1–2.6)	.015	2.4 (1.5–4.0)	<.001
No	1 [Reference]		1 [Reference]	

Abbreviations: BRFSS, Behavioral Risk Factor Surveillance System; CI, confidence interval; COPD, chronic obstructive pulmonary disease; OR, odds ratio.
[a] ORs adjusted for demographics (sex, age group, race/ethnicity), having a personal doctor, smoking status, and heavy drinking. Significance set at $P < .01$.
[b] Cardiovascular disease includes coronary heart disease, angina, congestive heart failure, high blood pressure, and stroke; COPD includes chronic obstructive pulmonary disease, emphysema, or chronic bronchitis.

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